TIMBER SUPPLY BRANCH

TIMBER SUPPLY REVIEW

Fort St. John Timber Supply Area Analysis Report

June 2002

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Fort St. John Timber Supply Area Analysis Report

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Preface

This report contains a timber supply analysis and a socio–economic analysis and is part of the provincial Timber Supply Review (TSR) carried out by the British Columbia Forest Service. The purpose of the review is to examine the short- and long-term effects of current forest management practices on the availability of timber for harvesting in timber supply areas (TSAs) and tree farm licences (TFLs) throughout British Columbia.

To determine allowable timber harvesting levels, the chief forester must have an up-to-date assessment of the timber supply based on the best available information and reflecting current management direction. **The report that follows provides this assessment but should not be considered as a recommendation on permissible harvest levels.**

This report focuses on a single forest management scenario — current management practices. Current management practices are defined by the specifications in management plans for the timber supply area including guidelines for the protection of forest resources, the *Forest Practices Code (FPC) of B.C. Act* and official land-use decisions made by Cabinet.

Focussing the assessment on the implications of current practices rather than looking at a number of different management regimes expedites the analysis process. An important part of these analyses is an assessment of how results might be affected by uncertainties — a process called sensitivity analysis. Together, the sensitivity analyses and the assessment of the effects of current forest management on the timber supply provide a basis for discussions among stakeholders about alternative timber harvesting levels.

In addition to having an up-to-date assessment of timber supply when setting the allowable annual cut (AAC) the chief forester considers short- and long-term implications of alternative harvest levels, capabilities and requirements of existing and proposed processing facilities, and the social and economic objectives of the Crown. The socio-economic analysis provides the chief forester with some of the information necessary for these considerations.

This report is the third of five documents that will be released for each TSA as part of the timber supply review. (The first two documents are the information report and the data package). A fourth document called the public discussion paper will summarize the technical information and will provide a focus for public discussions of possible timber harvest levels. The fifth will outline the chief forester's harvest level decision and the reasoning behind it.

Executive Summary

As part of the provincial Timber Supply Review, the British Columbia Forest Service has examined the availability of timber in the Fort St. John Timber Supply Area (TSA). The analysis assesses how current forest management practices affect the supply of wood available for harvesting over the short- (next 20 years), medium- (21 years to 100 years from the present) and long- (beyond 100 years from the present) terms. It also examines the potential changes in timber supply stemming from uncertainties about forest growth and management actions. **It is important to note that the various harvest forecasts included in the report indicate only the timber supply implications of current practices and uncertainty. As such, the forecasts should be used for discussion purposes only; they are not allowable annual cut (AAC) recommendations.**

The Fort St. John Timber Supply Area (TSA) covers approximately 4 676 600 hectares in north-eastern British Columbia. The TSA is bounded by the Alberta border to the east, the height of the Rocky Mountains to the west, the Fort Nelson TSA to the north and the Peace River to the south. About 48% of the Fort St. John TSA (approximately 2 243 300 hectares) is considered productive forest area managed by the Crown. Currently about 47% of the productive forest, or 23% of the total TSA, is considered available for timber harvesting under current forest management practices. The current timber harvesting land base is 1 058 540 hectares of which 733 221 hectares are dominated by coniferous species and 325 318 hectares are dominated by deciduous species. Aspen, lodgepole pine and white spruce are the dominant tree species within the area available for timber harvesting. Forest management practices in the TSA follow the *Forest Practices Code (FPC)* and the guidance provided by the Fort St. John Land and Resource Management Plan (LRMP).

The current AAC for the Fort St. John TSA is 2 015 000 cubic metres per year (excluding allocated woodlots), of which 1 100 000 cubic metres are from predominantly coniferous stands and 915 000 cubic metres from predominantly deciduous stands.

In the previous analysis, the coniferous stands included small pine, but in this analysis it was decided to show the small pine component separately from the main coniferous component.

Small pine stands include lodgepole pine stands greater than 80 years of age and between 17.7 and 19.4 metres in height. Analysis results suggest that it is possible to harvest 110 000 cubic metres per year for 160 years, after which the harvest level would have to decrease to the long-term harvest level of 99 000 cubic metres per year.

Coniferous stands include stands dominated by subalpine fir, lodgepole pine and white spruce that exceed 19.4 metres in height or have the potential to grow to at least 19.4 metres in height by age 80 years. Results suggest that the coniferous timber supply can be maintained at 1 694 000 metres per year over the long term.

Finally, deciduous stands include stands dominated by aspen. Results suggest that the current AAC for deciduous stands (915 000 cubic metres per year) could be maintained for 30 years, after which it would have to decrease by 10% per decade until the long-term harvest level of 632 000 cubic metres per year is reached.

These results reflect current knowledge and information on forest inventory, growth, and management. However, uncertainty exists about several factors important in defining timber supply. A series of sensitivity analyses shows that these uncertainties could affect timber supply to varying degrees.

The timber supply analysis examined the impact of increasing the initial harvest levels by increments of 10%. Results from the coniferous land base show that initial increases are not possible without disruptions in long-term timber supply. Conversely, the analysis shows that an initial increase of 10% is possible for the deciduous timber supply and a 20% increase is possible for the small pine timber supply with only a small disruption to the long-term timber supply.

Executive Summary

Currently there is a small market for aspen species within the Fort St. John TSA. However, plans are underway for the construction of a mill using aspen to produce oriented strand board. Sensitivity analysis indicates that if the aspen portion is not harvested from coniferous "mixed-wood" stands (18.5% of the timber harvesting land base) the coniferous harvest level would have to decrease by 9%, or 152 000 cubic metres per year. If the coniferous component is not harvested from deciduous "mixed-wood" stands, which cover 13.6% of the timber harvesting land base, the initial deciduous harvest level of 915 000 cubic metres per year could only be maintained for 10 years and the long-term harvest would have to decrease by 24.4% to 478 000 cubic metres per year.

The largest source of uncertainty in the analysis is the estimation of aspen and mixed-wood stand volumes. Data suggest that the volume in stands between 50 and 100 years old is underestimated. Ministry of Forests district staff believe volumes are underestimated in stands of all ages. A sensitivity analysis was performed where aspen volumes were increased by 20 and 40%. Results show that if aspen volumes are increased by 20%, the initial aspen harvest level could be maintained for 100 years and the long-term harvest level would be increased.

A second source of uncertainty with the deciduous harvest is the economic feasibility of harvesting in the north-east portions of the TSA (timber supply Block F). Sensitivity analysis shows that if there is no deciduous harvest in this portion of the TSA, the initial deciduous harvest level can only be maintained for one decade and the long-term harvest level would decrease by 22% or 140 000 cubic metres per year.

Industry representatives suggest that the base case underestimates the amount of merchantable stands in the TSA. Sensitivity analysis was performed in which the merchantability criterion was changed to a minimum volume of 100 cubic metres per hectare for the conventional land base and 200 cubic metres per hectare for the cable/helicopter land base. Results show the coniferous harvest could increase by 67 000 cubic metres per year (4.0%) and the deciduous long-term harvest level could increase by 82 000 cubic metres per year (13%).

In the base case, stands are assumed to be harvested randomly, subject to some priorities for certain needs, such as those identified in the development plan. If however the oldest stands are prioritized first, sensitivity analysis shows that timber supply would be increased. Fort St. John Forest District staff believe that the random rule as used in the base case is more representative of the actual harvest. Review of the stands allocated in development plan supports the use of the modified random rule.

The remaining sensitivity analyses exploring uncertainty in data or current performance show that the overall timber supply is not affected by more than 10%.

The conifer harvest level is modelled as even-flow so any uncertainty that affects the coniferous timber supply changes it for the entire planning horizon. For the deciduous and small pine timber supplies in general the initial harvest levels can be maintained, with most timber supply changes occurring in the medium- to long-term.

The oil and gas industry in the Fort St. John TSA is the leading source of employment and income for local residents, followed by the public sector and the travel sector (highly dependent on the temporary workforce of the oil and gas sector). Forestry supports approximately 9% of the area's labour force.

From 1999 to 2001, the volume of timber harvested in the Fort St. John TSA averaged approximately one million cubic metres per year, which is about 50% of the current AAC. This harvest has supported about 670 direct person-years of employment and a further 770 person-years of indirect and induced employment. Residents of the TSA accounted for about 62% of this total employment.

The current AAC of 2 015 000 cubic metres has been completely apportioned; however, not all operations are completely functional at this time. It is anticipated that when this AAC is fully harvested and processed, it will support about 1,350 person-years of direct forestry employment and a further 1,552 person-years of indirect and induced employment across the province. The employment income associated with this direct, indirect and induced employment would be about $116.9 million per year.

Executive Summary

Increasing the timber supply to the projected level of 2 713 400 cubic metres per year would provide additional opportunities; however, it is uncertain if demand and processing capacity would increase to use this additional volume. Current employment and income levels can be expected to continue, given the stable timber supply indicated by the timber supply forecast and assuming accessibility of markets and market demand. Employment can be expected to increase with the development of the Slocan-LP oriented strandboard plant.

Based on the average 1999-2001 harvest, the provincial government currently collects about $37.2 million per year in stumpage and related payments, other industry taxes and provincial income taxes.

Table of Contents

PREFACE III

EXECUTIVE SUMMARY IV

INTRODUCTION 1

1 DESCRIPTION OF THE FORT ST. JOHN TIMBER SUPPLY AREA 4

1.1 THE ENVIRONMENT 7
1.2 FIRST NATIONS 9
1.3 FORT ST. JOHN TSA RESULTS BASED PILOT PROJECT 9

2 INFORMATION PREPARATION FOR THE TIMBER SUPPLY ANALYSIS 10

2.1 LAND BASE INVENTORY 10
2.2 TIMBER GROWTH AND YIELD 21
2.3 MANAGEMENT PRACTICES 22

3 TIMBER SUPPLY ANALYSIS METHODS 27

4 RESULTS 28

4.1 BASE CASE HARVEST FORECAST 28
4.2 BASE CASE HARVEST FORECAST ASSUMPTIONS AND DYNAMICS 30
4.3 AREA, AVERAGE VOLUME AND AVERAGE AGE HARVESTED 34
4.4 AGE CLASS PROFILE OVER TIME 37

5 TIMBER SUPPLY SENSITIVITY ANALYSES 39

5.1 ALTERNATIVE HARVEST FORECASTS 40
5.2 UNCERTAINTY IN THE HARVEST PRIORITIES AND HARVEST RULE ASSUMPTIONS 42
5.3 UNCERTAINTY IN THE RATE OF NATURAL DISTURBANCE ON THE NON-TIMBER HARVESTING LAND BASE 43
5.4 UNCERTAINTY IN THE LAND BASE AVAILABLE FOR TIMBER HARVESTING 44
5.5 UNCERTAINTY IN THE AGRICULTURAL LAND RESERVE LAND BASE 48
5.6 UNCERTAINTY IN EXISTING STAND VOLUME ESTIMATES — THE 1995 INVENTORY AUDIT 49
5.7 UNCERTAINTY IN MANAGED STAND VOLUME ESTIMATES 52
5.8 UNCERTAINTY IN THE MIXED-WOOD HARVEST LEVELS 53
5.9 UNCERTAINTY IN STAND MERCHANTABILITY DEFINITION 54
5.10 UNCERTAINTY IN UNSALVAGED LOSSES 55
5.11 UNCERTAINTY IN MINIMUM HARVESTABLE AGES 55
5.12 UNCERTAINTY IN GREEN-UP AGES 57
5.13 UNCERTAINTY IN ADJACENCY RESTRICTIONS AND MODELLING APPROXIMATIONS 57
5.14 UNCERTAINTY IN FOREST COVER REQUIREMENTS FOR VISUAL QUALITY OBJECTIVES 58
5.15 UNCERTAINTY IN APPLICATION OF SERAL STAGE* RETENTION RECOMMENDATIONS 59
5.16 UNCERTAINTY IN SITE PRODUCTIVITY ESTIMATES 60

6 SUMMARY AND CONCLUSIONS OF THE TIMBER SUPPLY ANALYSIS 61

Table of Contents

7 SOCIO-ECONOMIC ANALYSIS 62
7.1 CURRENT SOCIO-ECONOMIC SETTING 62
7.1.1 Current population and demographic trends 62
7.1.2 Economic profile 63
7.2 FORT ST. JOHN TSA FOREST INDUSTRY 65
7.2.1 Current allowable annual cut 65
7.2.2 Fort St. John TSA harvest history 66
7.2.3 Fort St. John TSA major licensees and processing facilities 67
7.2.4 Forestry sector employment and employment coefficients 69
7.2.5 Fort St. John TSA employment income 71
7.2.6 Provincial government revenues 71
7.3 SOCIO-ECONOMIC IMPLICATIONS OF THE BASE CASE HARVEST FORECAST 72
7.3.1 Short- and long-term implications of alternative harvest levels 73
7.3.2 Community-level impacts 75
7.3.3 Nature, production capabilities and timber requirements of processing facilities 75
7.3.4 Regional timber supply issues 75
7.4 SUMMARY 75
8 REFERENCES 77
9 GLOSSARY 78
APPENDIX A DESCRIPTION OF DATA INPUTS AND ASSUMPTIONS FOR THE TIMBER SUPPLY ANALYSIS 85
INTRODUCTION 86
A.1 INVENTORY INFORMATION 87
A.2 ZONE AND ANALYSIS UNIT DEFINITIONS 90
A.3 DEFINITION OF THE TIMBER HARVESTING LAND BASE 95
A.4 FOREST MANAGEMENT ASSUMPTIONS 106
A.5 VOLUME ESTIMATES FOR EXISTING STANDS 123
A.6 VOLUME ESTIMATES FOR REGENERATED STANDS 130
APPENDIX B SOCIO-ECONOMIC ANALYSIS BACKGROUND INFORMATION 137
B.1 LIMITATIONS OF ECONOMIC ANALYSIS 138
B.2 ECONOMIC IMPACT ANALYSIS METHODOLOGY 139

Table of Contents

Tables

Table 1. Species at risk under the Forest Practices Code (February 1999) 8
Table 2. Determination of the timber harvesting land base for the Fort St. John TSA 13
Table 3. Summary of biogeoclimatic zone areas — Fort St. John TSA, 2002 16
Table 4. Composition of the timber harvesting land base 17
Table 5. Impacts of allowing stands on the non-timber harvesting land base to age indefinitely — Fort St. John TSA, 2002 44
Table 6. The impacts of removing unconventional harvest areas from the timber harvesting land base — Fort St. John TSA, 2002 47
Table 7. Agricultural land reserve land base sensitivity analysis — Fort St. John TSA, 2002 48
Table 8. The effect on the harvest forecast of increasing existing volume estimates by 10% — Fort St. John TSA, 2002 50
Table 9. The effect on the harvest forecast of decreasing existing volume estimates by 10% — Fort St. John TSA, 2002 50
Table 10. The effect on the harvest forecast of increasing aspen analysis unit volumes by 20% — Fort St. John TSA, 2002 51
Table 11. The effect on the harvest forecast of increasing aspen analysis unit volumes by 40% — Fort St. John TSA, 2002 52
Table 12. The effect on the harvest forecast of increasing managed stand yields by 10% — Fort St. John TSA, 2002 52
Table 13. The effect on the harvest forecast of decreasing managed stand yields by 10% — Fort St. John TSA, 2002 53
Table 14. Mixed-wood sensitivity analysis — remove deciduous species from the coniferous mixed-wood stands — Fort St. John TSA, 2002 53
Table 15. Mixed-wood sensitivity analysis — remove coniferous species from the deciduous mixed-wood stands — Fort St. John TSA, 2002 54
Table 16. Reduction of minimum merchantability requirements — Fort St. John TSA, 2002 55
Table 17. Effect of increasing minimum harvestable ages by 10 years — Fort St. John TSA, 2002 56
Table 18. Effect of decreasing minimum harvestable ages by 10 years — Fort St. John TSA, 2002 56
Table 19. Impact of increasing the adjacency requirement from 40% to 25% — Fort St. John TSA, 2002 57
Table 20. Impact of using the lower end of the visible disturbance range in areas managed for visual quality — Fort St. John TSA, 2002 58
Table 21. Impact of using the 45/45/10 procedure to set old-seral targets for landscape level biodiversity — Fort St. John TSA, 2002 60
Table 22. Fort St. John Forest District population statistics, 1991-2005 62
Table 23. Employment multipliers, by sector, Fort St. John Forest District, 1996 65
Table 24. Fort St. John TSA allowable annual cut, by licence type 65
Table 25. Fort St. John TSA volumes billed, by licence type, 1993 to 2000 66
Table 26. Canfor volumes billed and provincial employment statistics 67
Table 27. Fort St. John TSA employment and employment coefficients,[8] average 1998-2000 70

Table of Contents

Tables (continued)

Table 28. Provincial average direct and indirect and induced incomes and total employment income, 1998-200071
Table 29. Average annual provincial government revenues, 1998-2000 ... 72
Table 30. Fort St. John TSA socio-economic impacts: base case harvest forecast ... 74
Table A-1. Inventory information ... 87
Table A-2. Objectives to be tracked ... 90
Table A–3. Definition of analysis units ... 92
Table A-4. Estimates for existing roads, trails, landings and other features ... 96
Table A–5. Riparian areas — wetlands[A] and lakes ... 97
Table A-6. River and stream categories for the Fort St. John TSA ... 98
Table A–7. Exclusion of specific, geographically defined areas ... 99
Table A–8. Description of operability types in the Fort St. John TSA ... 99
Table A-9. Non–merchantable stand criteria ... 100
Table A-10. Description of sites with low timber growing potential — older stands ... 101
Table A-11. Description of sites with low timber growing potential — younger stands ... 102
Table A–12. Per cent area exclusions by recreation feature significance and management class ... 103
Table A–13. Description of environmentally sensitive areas ... 104
Table A–14. Utilization levels ... 106
Table A–15. Minimum harvestable age criteria ... 107
Table A–16. Minimum harvestable ages for the current timber harvesting land base ... 108
Table A-17. Minimum harvestable ages for the future, managed timber harvesting land base ... 110
Table A-18. Unsalvaged losses[A] — timber harvesting land base ... 112
Table A-19. Regeneration assumptions by analysis unit ... 113
Table A-20. Immature plantation history ... 114
Table A-21. Not satisfactorily restocked (NSR) areas-silvicultural records ... 115
Table A-22. Caribou habitat area forest cover requirement ... 117
Table A-23. VQO and IRM forest cover requirements ... 118
Table A-24. Draft landscape unit and biodiversity emphasis options ... 119
Table A-25. Landscape unit biodiversity requirements within the Fort St. John TSA ... 120
Table A-26. Recommended WTP reductions by landscape unit, BEC zone and coniferous/deciduous content ... 122
Table A-27. Timber volume tables for existing natural stands (cubic metres per hectare) ... 123
Table A-28. Timber volume tables for managed stands (cubic metres per hectare) ... 130
Table B-1. Total employment multipliers ... 141
Table B-2. Estimates of provincial government revenue — Fort St. John TSA ... 142

Table of Contents

Figures

Figure 1. Map of the Fort St. John Timber Supply Area, Prince George Forest Region. 6
Figure 2. Biogeoclimatic variants in the Crown forested area — Fort St. John TSA, 2002....15
Figure 3. Timber harvesting land base by analysis unit and maturity — Fort St. John TSA, 2002. 18
Figure 4. Timber harvesting land base by timber growing potential — Fort St. John TSA timber harvesting land base, 2002....19
Figure 5. Current age class composition — Fort St. John TSA forested land base, 2002. 20
Figure 6. Crown forest land base by management emphasis — Fort St. John TSA, 2002. 25
Figure 7. Area within the TSA managed by visual quality objective (VQO) in the Fort St. John TSA....26
Figure 8. Area within the TSA managed for caribou habitat — Fort St. John TSA 2002....26
Figure 9. Base case harvest forecast — Fort. St. John TSA, 2002....29
Figure 10. Harvest transition from existing to managed stands — Fort St. John TSA, 2002....31
Figure 11. Total and merchantable growing stocks — Fort St. John TSA, 2002....32
Figure 12. Total and merchantable growing stock by harvest component — Fort St. John TSA, 2002. 33
Figure 13. Average harvest age by harvest component — Fort St. John TSA, 2002. 34
Figure 14. Average volume per hectare harvested — Fort St. John TSA, 2002. 35
Figure 15. Average area harvested — Fort St. John TSA, 2002. 36
Figure 16. Changes in age composition on the productive land base over time — Fort St. John TSA base case, 2002.38
Figure 17. Increase initial coniferous harvest by 10% — Fort St. John TSA, 2002....40
Figure 18. Increase initial deciduous harvest by 10% and small pine harvest by 20% — Fort St. John TSA, 2002. 41
Figure 19. No harvest priorities — Fort St. John TSA, 2002....42
Figure 20. Relative oldest first harvest rule — Fort St. John TSA, 2002. 43
Figure 21. Impacts of a 10% reduction in the timber harvesting land base — Fort St. John TSA, 2002....45
Figure 22. Economic uncertainty of harvesting aspen in the north-east portion of the TSA — Fort St. John TSA, 2002. 46
Figure 23. Fort St. John TSA experienced labour force by sector, 1996. 63

Introduction

Timber supply* is the quantity of timber available for harvest over time. Timber supply is dynamic, not only because trees naturally grow and die, but also because conditions that affect tree growth, and the social and economic factors that affect the availability of trees for harvest, change through time.

Assessing the timber supply involves considering physical, biological, social and economic factors for all forest resource values, not just for timber. Physical factors include the land features of the area under study as well as the physical characteristics of living organisms, especially trees. Biological factors include the growth and development of living organisms. Economic factors include the financial profitability of conducting forest operations, and the broader community and social aspects of managing the forest resource.

All of these factors are linked: the financial profitability of harvest operations depends upon the terrain, as well as on the physical characteristics of the trees to be harvested. Determining the physical characteristics of trees in the future requires knowledge of their growth. Decisions about whether a stand is available for harvest often depend on how its harvest could affect other forest values, such as wildlife or a recreation area.

These factors are also subject to both uncertainty and different points of view. Financial profitability may change as world timber markets change. Unforeseen losses due to fire or pest infestations will alter the amount and value of timber. The appropriate balance of timber and non-timber values in a forest is an ongoing subject of debate, and is complicated by changes in social objectives over time.

Thus, before an estimate of timber supply is interpreted, the set of physical, biological and socio-economic conditions on which it is based, and which define current forest management — as well as the uncertainties affecting these conditions — must first be understood. Timber supply analysis is the process of assessing and predicting the current and future timber supply for a management unit (a geographic area). For a timber supply area (TSA)*, the timber supply analysis forms part of the information used by the chief forester of British Columbia in determining an allowable annual cut (AAC)* — the permissible harvest level for the area.

Timber supply projections made for TSAs look far into the future — 250 years or more. However, because of the uncertainty surrounding the information and because forest management objectives change through time, these projections should not be viewed as static prescriptions that remain in place for that length of time. They remain relevant only as long as the information upon which they are based remains relevant. Thus, it is important that re-analysis occurs regularly, using new information and knowledge to update the timber supply picture. This allows close monitoring of the timber supply and of the implications for the AAC stemming from changes in management practices and objectives.

**Throughout this document, an asterisk after a word or phrase indicates that it is defined in a box at the foot of the page, as well as in the glossary.*

Timber supply
The amount of timber that is forecast to be available for harvesting over a specified time period, under a particular management regime.
Timber supply area (TSA)
An integrated resource management unit established in accordance with Section 7 *of the* Forest Act.

Allowable annual cut (AAC)
The rate of timber harvest permitted each year from a specified area of land, usually expressed as cubic metres of wood per year.

Introduction

Timber supply analysis involves three main steps. The first step is collecting and preparing data and information. The B.C. Forest Service forest inventory* plays a major role in this step. The second step is using the data along with a timber supply computer model or models* to make projections or estimates of possible harvest levels over time. These projections are made using different sets of assumed values or conditions for the factors discussed above. The third step is interpreting and reporting results.

The following sections outline the timber supply analysis for the Fort St. John TSA. Following a brief description of the area in Section 1, data preparation and formulation of assumptions are discussed in Section 2. Timber supply analysis methodology and results are presented in Sections 3 and 4. Section 5 examines the sensitivity of the results to uncertainties in the data and assumptions used. This is followed by summary and conclusions for the timber supply analysis in Section 6. Section 7 shows results of a socio-economic analysis for the Fort St. John TSA. Appendixes A and B contain further details about the data and assumptions used in the analysis.

As part of the timber supply review (TSR), information is gathered on the short- and long-term implications of alternative harvest levels, and the capabilities and requirements of existing and proposed processing facilities. The socio-economic analysis provides information for the chief forester and the local community to better understand the potential magnitude of impacts associated with any proposed harvest level changes.

The socio-economic analysis considers the current and projected levels of forestry activity associated with the Fort St. John TSA within the context of regional timber supplies and production capacity. It does this by examining the profile of the region and the local forest industry; and by assessing employment and income implications of the timber harvesting levels projected in the base case.

The analysis includes estimates of the employment and income impacts associated with timber supply analysis projections by three main sectors: harvesting and other woodlands-related, processing, and silviculture. Employment is measured in person-years*. Employment income is calculated using average industry income estimates.

Data on direct employment, harvest levels, and fibre flows were obtained by surveying licensees and mill operators. The information was used to estimate harvesting, processing and silviculture direct employment averages associated with the harvest and the proportion of workers living in the area. The estimates of local and provincial harvesting, processing, and silviculture direct employment were then used to determine ratios of employment per 1000 cubic metres of timber harvested.

Forest inventory
An assessment of British Columbia's timber resources. It includes computerized maps, a database describing the location and nature of forest cover, including size, age, timber volume, and species composition, and a description of other forest values such as recreation and visual quality.
Model
An abstraction and simplification of reality constructed to help understand an actual system or problem. Forest managers and planners have made extensive use of models, such as maps, classification systems and yield projections, to help direct management activities.

Person—year(s)
One person working the equivalent of one full year, defined as at least 180 days of work. Someone working full—time for 90 days accounts for 0.5 person—years.

Introduction

Indirect and induced employment figures were calculated using the Fort St. John TSA and provincial employment multipliers* developed by the Ministry of Finance. Indirect impacts result from direct businesses purchasing goods and services; induced impacts result from direct employees purchasing goods and services. Employment coefficients* per 1000 cubic metres were also determined for the indirect and induced impacts.

To estimate the level of employment that could be supported by alternative harvest rates, projected timber supply levels were multiplied by the calculated employment coefficients. It should be noted that employment coefficients are based on current productivity, harvest practices and management assumptions* and will not likely reflect industry conditions decades into the future. As such, the employment estimates can only be viewed as general indicators.

Employment multiplier
An estimate of the total employment supported by each direct job, for example a multiplier of 2.0 means that one direct job supports one additional indirect and induced job.

Employment coefficient
The number of person—years of employment supported by every 1000 cubic metres of timber harvested; for example, a coefficient of 1.0 indicates that every 1000 cubic metres harvested supports one person-year, or 500 000 cubic metres supports 500 person-years.

Management assumptions
Approximations of management objectives, priorities, constraints and other conditions needed to represent forest management actions in a forest planning model. These include, for example, the criteria for determining the timber harvesting land base, the specification of minimum harvestable ages, utilization levels, integrated resource guidelines and silviculture and pest management programs.

1 Description of the Fort St. John Timber Supply Area

The Fort St. John Timber Supply Area (TSA) covers approximately 4.7 million hectares in the northeastern part of British Columbia, and is one of six TSAs that form the Prince George Forest Region. The Fort St. John TSA is bounded by the Alberta border to the east, the height of the Rocky Mountains to the west, the Fort Nelson TSA to the north and the Peace River to the south. The boundaries of the Fort St. John TSA are the same as those of the Fort St. John Forest District, which is administered by the district office in Fort St. John.

A vast plateau intersected by streams in deep gullies dominates the eastern part of the Fort St. John TSA. Moving westward, the plateau gives way to a rolling, hilly landscape and finally to the steeper terrain of the Rocky Mountains. Rivers are the dominant water features, as lakes tend to be small and shallow. The major rivers include the Sikanni Chief, Beatton, Halfway, Chowade, Graham, Ettithun and Fontas. Engelmann spruce and subalpine fir forests dominate the mountains and river valleys to the west while the eastern plateau supports mostly boreal spruce and trembling aspen forests. White spruce, lodgepole pine, aspen, black spruce and subalpine fir are the main tree species occurring in the TSA, and these species frequently grow as mixed-wood* stands.

Numerous natural resources and values are associated with the forested land base in the Fort St. John TSA including forest products, guide-outfitting, trapping, ranching, wildlife habitat, outdoor recreation, tourism amenities, and oil and gas exploration and development. Commercial livestock grazing is a widespread use of public forest land. Parks, recreation sites and trails, and roaded and non-roaded areas provide numerous opportunities to enjoy the outdoors, and the large amount of unroaded area is an important feature for outdoor recreation. Depending on the season, activities include camping, horseback riding, hunting, snowmobiling, ATV riding, fishing, river-boating, and wildlife viewing.

In 2001, B.C. Statistics data estimated the population of the Fort St. John TSA at 28,250 people. The largest communities in the TSA are Fort St. John and Taylor, with populations of 16,039 and 1,143 respectively. First Nations communities in the TSA include settlements at Halfway River, Blueberry River, Doig River and Kahntah.

In October, 1997, the Fort St. John Land and Resource Management Plan (LRMP)*, which guides management of all Crown land in the TSA, was approved by government. The plan includes recommendations for the designation of new provincial parks and guides ongoing resource management activities and forest development planning. Eleven new protected areas* were recommended, comprising about 4% of the TSA. Five of those have been established as Class A parks and three are protected areas under the *Protected Area Act*; these parks and protected areas will not contribute to the timber supply. The three other areas are not considered protected and are eligible to contribute to timber supply.

The LRMP divides the TSA into resource management zones based on resource values, existing economic activity, environmentally important areas, and agricultural land reserve (ALR) boundaries. Land-use planning decisions regarding forest practices that have been implemented are reflected in this timber supply analysis.

Mixed-wood
Forests that have a mix of coniferous and deciduous trees.
Land and Resource Management Plan (LRMP)
A strategic, multi-agency, integrated resource plan at the subregional level. It is based on the principles of enhanced public involvement, consideration of all resource values, consensus-based decision making, and resource sustainability.

Protected area
A designation for areas of land and water set aside to protect natural heritage, cultural heritage or recreational values (may include national park, provincial park, or ecological reserve designations).

1 Description of the Fort St. John Timber Supply Area

A large contiguous area known as the Muskwa-Kechika covers the western portion of the Fort St. John TSA as well as parts of the Fort Nelson and Mackenzie TSAs. An important part of the Fort St. John LRMP was the designation of the Muskwa-Kechika management area, which contains protected areas and special management zones. Management objectives for this area ensure that wilderness characteristics and wildlife habitat are maintained, while allowing some resource development.

The current allowable annual cut (AAC) in the Fort St. John TSA is 2.015 million cubic metres, partitioned* into 1.1 million cubic metres for harvesting within predominantly coniferous* stands and 915,000 cubic metres for harvesting within predominantly deciduous* stands. The AAC was set by the chief forester effective December 31, 1996, and represented a 12% increase from the previous level.

Partition
A portion of the AAC that is attributable to certain types of timber and/or terrain.
Coniferous
Coniferous trees have needles or scale-like leaves and are usually 'evergreen'.

Deciduous
Deciduous trees shed their leaves annually and commonly have broad-leaves.

1 Description of the Fort St. John Timber Supply Area

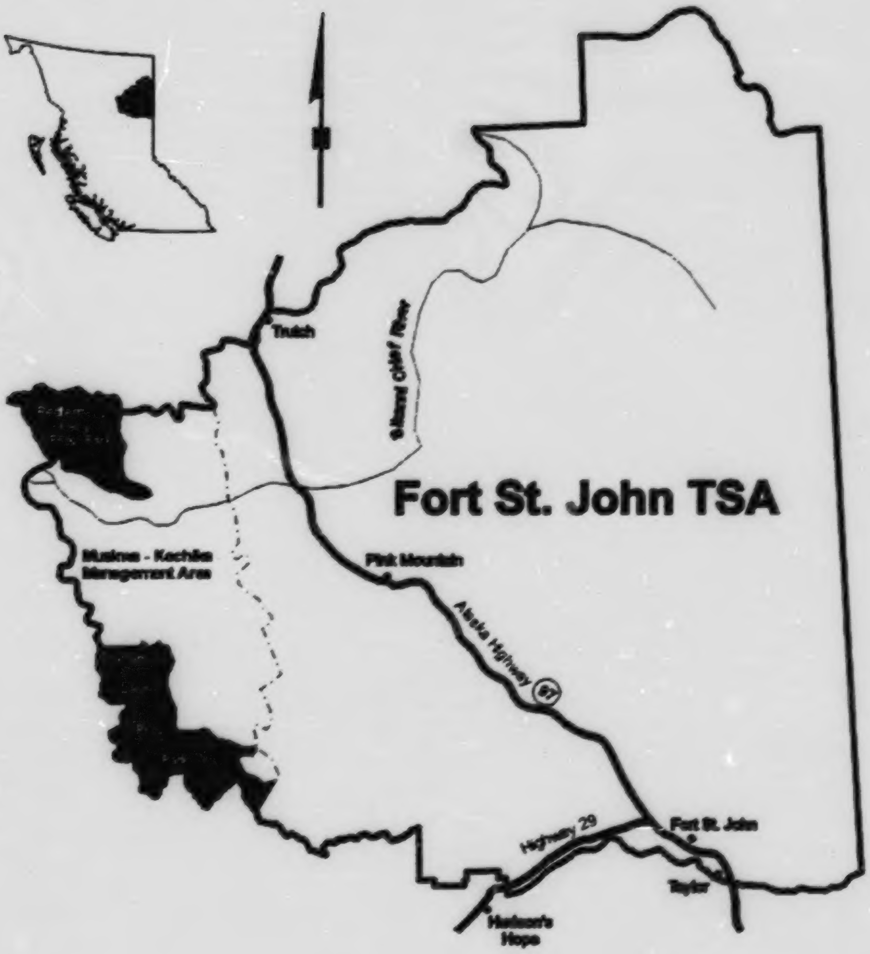
Trutch
Sikanni Chief River
Fort St. John TSA
Muskwa - Kechika
Management Area
Pink Mountain
Alaska Highway
97
Highway 29
Fort St. John
Taylor
Hudson's
Hope

Figure 1. Map of the Fort St. John Timber Supply Area, Prince George Forest Region.

1 Description of the Fort St. John Timber Supply Area

About 48% of the TSA land base is productive forest land managed by the B.C. Forest Service (approximately 2 243 300 hectares). Currently about 47% of this forested land base is considered available for harvesting (23% of the total TSA land base).

Significant changes that influence forest management have occurred since the last timber supply review was completed. These changes include:

- implementation of the *Forest Practices Code (FPC)**;
- approval of the Fort St. John Land and Resource Management Plan (LRMP);
- consideration of draft landscape units (LU)* and biodiversity emphasis options;
- re-inventory of portions of the TSA;
- implementation of procedures to identify the location, volume and species of salvage timber;
- completion of new operability* mapping;
- stand-level biodiversity* by management practices;
- revision of low productivity criteria;
- exclusion of cottonwood-leading stands from the timber harvesting land base*;
- update of the recreation features inventory; and
- reduction of non-recoverable losses (NRL) by 99 100 cubic metres per year.

1.1 The environment

The four biogeoclimatic zones* that occur in the Fort St. John TSA reflect the diversity of climate and vegetation in the area. Fire has historically been the dominant agent of disturbance on the landscape and has largely determined the types of forests currently found on the land base.

The Boreal White and Black Spruce (BWBS) zone is the most widespread, covering about two-thirds of the TSA. This zone occupies the plateau in the eastern and central part of the TSA, as well as low elevations towards the west. The BWBS zone has a northern continental climate, with long, very cold winters and short growing seasons. White spruce, trembling aspen, lodgepole pine and black spruce are the major tree species found in this zone. Forest fires are frequent and maintain most of the forests in various successional stages.

In the northern portion of the mountainous western part of the TSA, the Spruce-Willow–Birch (SWB) zone occurs at elevations above the BWBS zone. The climate is characterized by long, cold winters and brief, cool summers. The dominant tree species found in this zone are white spruce and subalpine fir, with lesser amounts of lodgepole pine, trembling aspen and black spruce.

Forest Practices Code
Legislation, standards and guidebooks that govern forest practices and planning, with a focus on ensuring management for all forest values.
Landscape unit
A planning area based on topographic or geographic features, that is appropriately sized (up to 100 000 hectares), and designed for application of landscape-level biodiversity objectives.
Operability
Classification of an area considered available for timber harvesting. Operability is determined using the terrain characteristics of the area as well as the quality and quantity of timber on the area.

Stand-level biodiversity
A stand is a relatively localized and homogeneous land unit that can be managed using a single set of treatments. In stands, objectives for biodiversity are met by maintaining specified stand structure (wildlife trees or patches), vegetation species composition and coarse woody debris levels.
Timber harvesting land base
Crown forest land within the timber supply area where timber harvesting is considered both acceptable and economically feasible, given objectives for all relevant forest values, existing timber quality, market values and applicable technology.
Biogeoclimatic zones
A large geographic area with broadly homogeneous climate and similar dominant tree species.

1 Description of the Fort St. John Timber Supply Area

In the southern portion of the mountainous western part of the TSA, the Engelmann Spruce–Subalpine Fir (ESSF) zone occurs above the BWBS zone. The ESSF zone has a relatively cold, moist and snowy continental climate. Growing seasons are cool and short with long, cold winters and deep snow cover. The ESSF zone has continuous forest at its lower elevations and parkland at its higher elevations. Subalpine fir is the dominant tree species throughout the zone; hybrid spruce (Engelmann and white) and lodgepole pine are common in drier parts of the zone that have been influenced by fire.

The Alpine Tundra (AT) zone occurs at high elevations above the ESSF and SWB zones. The climate is cold, windy and snowy with a short, cool growing season. Frost can occur at any time during the year. By definition this zone is treeless, although trees in stunted form are common at lower elevations. Vegetation is dominated by shrubs, herbs, mosses and lichens. Much of the alpine landscape lacks vegetation and is covered by rock, ice and snow.

The Fort St. John TSA supports thriving populations of large mammals, including black bear, grizzly bear, mountain goat, elk, mountain sheep, Stone's sheep, white-tailed deer, mule deer, caribou and moose. Healthy populations of furbearers, birds and fish are also found. The network of rivers and streams support 12 species of fish including mountain whitefish, Arctic grayling, rainbow trout, lake whitefish and walleye. Significant populations of bull trout, northern pike, goldeye, yellow perch and burbot are also found.

Under the *Forest Practices Code*, a process exists for identifying species at risk and designating wildlife habitat areas with specific management practices. The wildlife species that have been identified in *Volume 1* of the provincial *Identified Wildlife Management Strategy* in the nine ecosections of the Fort St. John Forest District are presented in Table 1. The ecosection name for each code is provided in the accompanying table. The Muskwa Plateau (MUP), Halfway Plateau (HAP) and Clear Hills (CLH) ecosections account for about three-quarters of the TSA land base.

Table 1. Species at risk under the Forest Practices Code (February 1999)

Common names of identified wildlife	**Ecosection**								
	MIR	**PEF**	**CLH**	**HAP**	**PEL**	**FNL**	**MUP**	**MUF**	**EMR**
Bull trout	x	X		x	x	x	x	x	x
American bittern			x		x				
Trumpeter swan		X	x	x	x	x	x		
Northern goshawk *atricapillus*	x	X	x	x	x	x	x	x	x
Sandhill crane				x		x		x	
Fisher	x	X	x	x	x	x	x	x	x
Grizzly bear	x	X	x	x	x	x	x	x	x
Mountain goat	X	X				x	x	x	x

Source: Managing Identified Wildlife, Volume 1, February 1999.

1 Description of the Fort St. John Timber Supply Area

Code	Ecosection
MIR	Missinchinka Ranges
PEF	Peace Foothills
CLH	Clear Hills
HAP	Halfway Plateau
PEL	Peace Lowland
FNL	Fort Nelson Lowland
MUP	Muskwa Plateau
MUF	Muskwa Foothills
EMR	Eastern Muskwa Ranges

Current forest management practices follow the legislation and guidelines set out by the *Forest Practices Code*. Consequently, the protection of wildlife and the environment will be managed through the *Code*. In addition, the Fort St. John LRMP provides further management direction for public forest lands in the Fort St. John TSA, as well as for wildlife species not included in the above list.

1.2 First Nations

The Fort St. John TSA lies within the area described as Treaty 8 Territory. Three First Nations in the TSA are signatories to Treaty 8: the Blueberry River First Nation, the Doig River First Nation and the Halfway River First Nation. These First Nations have reserve lands and traditional territories within the TSA. The Kahntah community, and Prophet River, West Moberly and Assumption First Nations have traditional territory but no reserve lands within the TSA.

First Nations members are involved in ranching, trapping, big game guiding, oil and gas exploration and development, and forestry activities within the TSA. An archaeological overview assessment, which identified sites of potential archaeological significance, has been completed. Other inventory studies to assess cultural heritage resources* (i.e., traditional use studies and archaeological impact assessments) are ongoing. Once these studies are completed, they will be considered in future timber supply reviews.

1.3 Fort St. John TSA results based pilot project

Under Part 10.2 of the *Forest Practices Code*, pilot projects may be established to test alternative methods of meeting the objectives of the *Code* while improving the regulatory framework. The emphasis is a shift from prescriptive management under the *Code* to results-based management. Under *the Fort St. John Pilot Project Regulation* (December 2001), the four licensees in the TSA, Canfor, Louisiana-Pacific, Slocan and the Ministry of Forests Small Business Forest Enterprise Program have jointly entered into a results-based pilot project. The five major objectives of the pilot project are to:1) incorporate landscape-level planning into forestry plans, using the Fort St. John LRMP as the guiding document, 2) combine individual forest development plans into one consolidated plan, 3) eliminate the need for individual approval of most site level plans, 4) establish a process for ongoing public involvement in forestry planning, and 5) test certification processes as a means to maintain or improve environmental performance. The core of the pilot project is a new document called the Sustainable Forest Management Plan (SFMP). Forest management in the TSA will be in a transition phase until the SFMP is completed and approved by government. It is expected to be completed by 2003.

Cultural heritage resource
An object, a site or the location of a traditional societal practice that is of historical, cultural or archaeological significance to the province, a community or an aboriginal people.

2 Information Preparation for the Timber Supply Analysis

Timber supply analysis requires three general categories of information: land base inventory; timber growth and yield data; and management practices. These three categories are discussed below. Also, in preparation for the analysis, a number of changes since the 1996 Fort St. John TSA timber supply analysis were noted, as described in Section 1, "Description of the Fort St. John TSA."

2.1 Land base inventory

Land base information used in this analysis was compiled in 2001 by the B.C. Forest Service. This file contains information on the forest land in the Fort St. John TSA including general geographic location, area, forest cover (such as presence or absence of trees, species, number of trees, age, and timber volume), and other characteristics such as environmental sensitivity and physical accessibility (operability). Stand attributes such as tree height, stocking* and age have been projected to 2000. The inventory file has been updated to account for timber harvesting using Forest Development Plan (FDP) information and is current to the end of 1999.

The inventory file represents the land base for the entire TSA. It includes information on land that does not contain forest, and other areas where timber harvesting is not expected to occur. Examples are land set aside for parks, areas needed to protect wildlife habitat, areas in utility and transportation corridors, and residential and industrial development. A description of these areas specific to the Fort St. John TSA is provided below. These types of areas do not contribute to the timber harvesting land base of the Fort St. John TSA. Before assessing timber supply, these non-contributing areas are identified as separate from the timber harvesting land base.

The B.C. Forest Service manages the entire area of the TSA (except for designated areas under the jurisdiction of other agencies) as a land unit that contributes a mix of timber and non-timber values. The timber supply is managed within this integrated resource context, and the analysis described herein is consistent with this philosophy.

Use of the term timber harvesting land base in this report does not mean the area is open to unrestricted logging. Rather, it implies that forests in the area contain timber of sufficient economic value, and sites of adequate environmental resilience, to accommodate timber harvesting with due care for other resources.

Stocking
The proportion of an area occupied by trees, measured by the degree to which the crowns of adjacent trees touch, and the number of trees per hectare.

The following describes the types of land that do not contribute to the timber harvesting land base.

- non-forest areas — areas not occupied by productive forest cover (e.g., rock, swamp, alpine areas and water bodies).
- woodlots — Crown managed productive forest excludes woodlots which are not administered as part of the TSA for AAC determination.
- not managed by the B.C. Forest Service — these are non-Crown areas such as private land, Indian reserves, federal and municipal lands.
- range leases — areas leased for agricultural activities.
- parks and reserves — these areas are not administered by the B.C. Forest Service but are explicitly identified since they contribute to landscape-level biodiversity* objectives.
- non-commercial cover areas — areas occupied by non-commercial tree and brush species.
- existing unclassified roads, trails and landings (RTLs) — areas of forest land that have been removed from timber production due to access development and harvesting to date.
- riparian area* — areas unavailable for harvesting to provide protection for riparian habitat*, stream ecosystems, and lakeshores.
- seismic lines — areas deforested for gas and mineral exploration.
- range and wildlife burns — areas that are periodically burned to generate habitat and forage for livestock and wildlife.
- inaccessible areas — areas where there are merchantable stands but the cost of extracting the wood is too high.
- inoperable — areas considered physically or economically inoperable. Physical operability was assessed using slope, lacustrine and non-lacustrine soils information. Economic operability was assigned using physical operability, minimum merchantability and harvesting system information (e.g., conventional *versus* cable/helicopter).

Landscape-level biodiversity
The Landscape Unit Planning Guide *provides objectives for maintaining biodiversity at both the landscape level and the stand level. At the landscape level, guidelines are provided for the maintenance of seral stage distribution, patch size distribution and landscape connectivity.*

Riparian area
Areas of land adjacent to wetlands or bodies of water such as swamps, streams, rivers or lakes.
Riparian habitat
The stream bank and flood plain area adjacent to streams or water bodies.

- non-merchantable forest types* — areas dominated by non-merchantable tree species.
- sites with low timber productivity — areas occupied by forest with low timber growing potential.
- recreation features — areas of high recreation value.
- environmentally sensitive areas (ESA)* — areas identified that have sensitive soils, avalanche potential, wildlife habitat or where it is difficult to regenerate a new crop of trees were completely or partially excluded from the timber harvesting land base.
- wildlife tree* patches (WTP) — areas retained to maintain mature stand structure over time for biodiversity* objectives.
- non-productive burn area — previously burned areas that are non-productive and classified as not satisfactory restocked (NSR)* that is not productive forest land.
- future roads, trails and landings — estimated forest land required to be removed from timber production due to future access development and harvesting.

A more detailed description of these categories, including specific criteria for exclusion is located in Appendix A, "Description of Data Inputs and Assumptions for the Timber Supply Analysis." Table 2 summarizes the areas in each category, and shows the area of the timber harvesting land base. The column "Crown forest area by classification" provides the total forested area managed by the B.C. Forest Service within the given category. For example, while there is a total of 43 033 hectares of forested land classified as inoperable, only 35 553 hectares were excluded at that point of the land base determination. The difference arises because the actual area excluded depends on the sequence of the reduction (e.g., areas previously excluded as utility corridors may have overlapped with inoperable stands, thus reducing the area explicitly excluded due to operablility).

Non-merchantable forest types
Stands that are accessible and otherwise available for harvesting but are assumed to be non-merchantable due to stand characteristics such as small piece size, incidence of decay, species composition and low stocking.
Environmentally sensitive areas
Areas with significant non-timber values, fragile or unstable soils, impediments to establishing a new tree crop, or high risk of avalanches.

Wildlife tree
A standing live or dead tree with special characteristics that provide valuable habitat for conservation or enhancement of wildlife.
Biodiversity (biological diversity)
The diversity of plants, animals and other living organisms in all their forms and levels of organization, including the diversity of genes, species and ecosystems, as well as the evolutionary and functional processes that link them.
Not satisfactorily restocked (NSR) areas
An area not covered by a sufficient number of well-spaced trees of desirable species. Stocking standards are set by the B.C. Forest Service. Areas harvested prior to October 1987 and not yet sufficiently stocked according to standards are classified as backlog NSR. Areas harvested or otherwise disturbed since October 1987 are classified as current NSR.

Table 2. Determination of the timber harvesting land base for the Fort St. John TSA

Classification	Crown forest area by classification (hectares)	Area (hectares)	Per cent (%) of TSA area	Per cent (%) of productive forest area
Total TSA area		4 676 636	100.0	
Non-forest land		2 121 261	45.4	
Woodlots		13 299	0.3	
Not managed by the B.C. Forest Service		208 696	4.5	
Range lease		10 373	0.2	
Parks and reserves[a]		79 750	1.7	
Total forested area managed by the B.C. Forest Service (Crown forest)		2 243 257	48.0	100.0
Reductions to Crown forest				
Non-commercial cover	157 233	157 233	3.4	7.0
Existing roads, trails and landings	7 088	6 670	0.1	0.3
Riparian areas — lakes and wetlands	16 082	14 022	0.3	0.6
Riparian areas — streams	77 757	67 824	1.5	3.0
Seismic lines	26 659	24 105	0.5	1.1
Range and wildlife burn areas	45 740	39 436	0.8	1.8
Inaccessible areas	6 602	6 243	0.1	0.3
Inoperable	43 033	35 569	0.8	1.6
Non-merchantable forest types — total	403 442	375 553	8.0	16.7
Coniferous stands	335 982	318 237		
Deciduous stands	67 460	57316		
Low productivity sites — total	536 999	319 226	6.8	14.2
Coniferous stands	382 661	185 925		
Deciduous stands	154 338	133 301		
Recreation features	74 601	41 841	0.9	1.9
Environmentally sensitive areas (ESA)	48 780	16 520	0.4	0.7
Wildlife tree patches (WTP) — total	86 179	45 392	1.0	2.0
Coniferous stands	60 464	31 351		
Deciduous stands	25 715	14 041		
Non-productive burn area	35 083	35 083	0.8	1.6
Total current reductions		1 184 717	25.3	52.8
Current timber harvesting land base Coniferous stands — 733 221 hectares Deciduous stands — 325 318 hectares		1 058 540	22.6	47.2
Future reductions — roads		5 838	0.1	0.3
Future timber harvesting land base		1 052 702	22.5	46.9

(a) Parks and reserve forested land base is used in the analysis to achieve landscape-level biodiversity objectives.

Table 2 shows that of the total Fort St. John TSA, 48% is productive forested land base. After reductions for other values or merchantability criteria, 47.2% of the productive forest or 22.6% of the TSA is available for timber harvesting activities. The changes in the land base from the previous analysis and foremost reasons for the changes follow:

- Total TSA area — the total area is 3587 hectares larger than the previous analysis. This difference in area is attributed to inventory update and minor changes to the Dawson Creek-Fort St. John TSA boundaries.
- Crown forest (productive forest land base) — the productive forest land base is 60 502 hectares smaller than the previous analysis. The difference in area is attributed to the creation of new parks and woodlots which have been excluded from the productive forest.
- Current timber harvesting land base — the timber harvesting land base is 135 584 hectares smaller than the previous analysis. The foremost reasons for the change in the land base since the last analysis are: less area in the deciduous land base due to revised low productivity criteria, revised operability mapping, exclusion of wildlife tree patches and non-recoverable NSR burn area, and change in the method used to estimate riparian area (inventory *versus* sample based).

Figure 2 and Table 3 show the distribution of the biogeoclimatic (BEC) variants* in the Crown forested area. Table 3 shows the proportion of each BEC variant that is not available for harvest. For example, ESSFmv2 variant makes up 0.5% of the total forested area and 0.4% of the timber harvesting land base, while 62.8% of the total area of ESSFmv2 is outside of the timber harvesting land base. The numbers in the last column of Table 3 suggest that the forest outside the timber harvesting land base will meet most of the old-seral* requirements if it is well-distributed among the landscape units (LU).

Biogeoclimatic (BEC) variant
A subdivision of a biogeoclimatic subzone. Variants reflect further differences in regional climate and are generally recognized for areas slightly drier, wetter, snowier, warmer or colder than other areas in the subzone.

Old seral
Old seral refers to forests with appropriate old forest characteristics. Ages vary depending on forest type and biogeoclimatic variant.

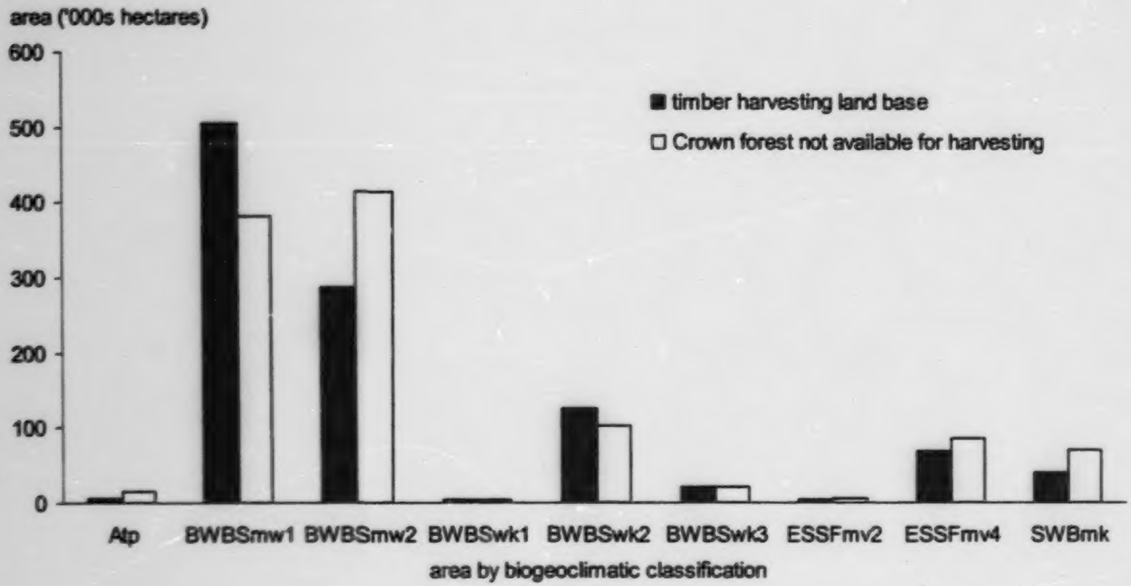

Figure 2. Biogeoclimatic variants in the Crown forested area — Fort St. John TSA, 2002.

Table 3. Summary of biogeoclimatic zone areas — Fort St. John TSA, 2002

Biogeoclimatic ecosystem classification (BEC) zone/variant	Per cent (%) of total forested area in the BEC variant	Per cent (%) of timber harvesting land base in BEC variant	Per cent (%) of BEC variant outside the timber harvesting land base
Atp	1.0	0.5	76.7
BWBSmw1—coniferous[a]	25.4	27.8	46.3
BWBSmw1—deciduous[a]	15.6	19.9	37.6
BWBSmw2—coniferous	24.3	19.5	60.6
BWBSmw2—deciduous	8.1	7.5	54.5
BWBSwk1—coniferous	0.2	0.3	42.0
BWBSwk1—deciduous	0.1	0.1	49.8
BWBSwk2—coniferous	8.3	8.8	48.3
BWBSwk2—deciduous	2.2	3.0	34.6
BWBSwk3—coniferous	1.7	1.9	45.4
BWBSwk3—deciduous	0.2	0.1	81.9
ESSFmv2	0.5	0.4	62.8
ESSFmv4	7.1	6.5	55.0
SWBmk	5.1	3.8	64.0
Total	100.0	100	Not applicable

(a) Landscape-level biodiversity objectives are defined for coniferous- and deciduous-stands.

2 Information Preparation for the Timber Supply Analysis

Table 4 shows the current composition of the timber harvesting land base by dominant tree species. Stands dominated by lodgepole pine occupy the most area (36%) followed by white spruce (34%) and aspen (30%). After harvest, pine and spruce dominated stands are generally regenerated to mixtures of pine and spruce. Aspen sites regenerate naturally to aspen with some supplemental planting of spruce or pine.

Table 4. Composition of the timber harvesting land base

Leading species	Area (hectares)	Per cent (%)
Aspen (> 80%)	181 214	17.1
Aspen mixes[a]	144 104	13.6
Lodgepole pine (> 80%)	118 370	11.2
Lodgepole pine mixes[a]	258 209	24.4
White spruce (> 80%)	155 862	14.7
White spruce mixes[a]	200 780	19.0
Total	1 058 539	100.0

(a) Leading species is less than 80%; for example aspen mixes may be composed of 60% aspen and 40% pine or spruce.

Analysis units (AU)* were derived by aggregating stands with similar species composition, site productivity and maturity classes (young, thrifty and old). The number of analysis units depends on the amount and distribution of stands with similar characteristics (see Appendix A, Section A.2.2, Analysis unit characteristics"). The following figures show generalized groupings by species composition, maturity and site index* ranges. Maturity is defined as stands being in a managed state (young) or having ages greater or lesser than minimum harvest age.

Analysis unit
A grouping of types of forest — for example, by species, site productivity, silvicultural treatment, age, and or location — done to simplify analysis and generation of timber yield tables.

Site index
A measure of site productivity. The indices are reported as the average height, in metres, that the tallest trees in a stand are expected to achieve at 50 years (age is measured at 1.3 metres above the ground). Site index curves have been developed for British Columbia's major commercial tree species.

Figure 3 shows the composition of the timber harvesting land base by analysis unit and maturity. Currently 5% of the land base is managed plantations, 30% is covered by natural stands less than minimum harvestable age (MHA) and 65% is covered by natural stands greater than MHA.

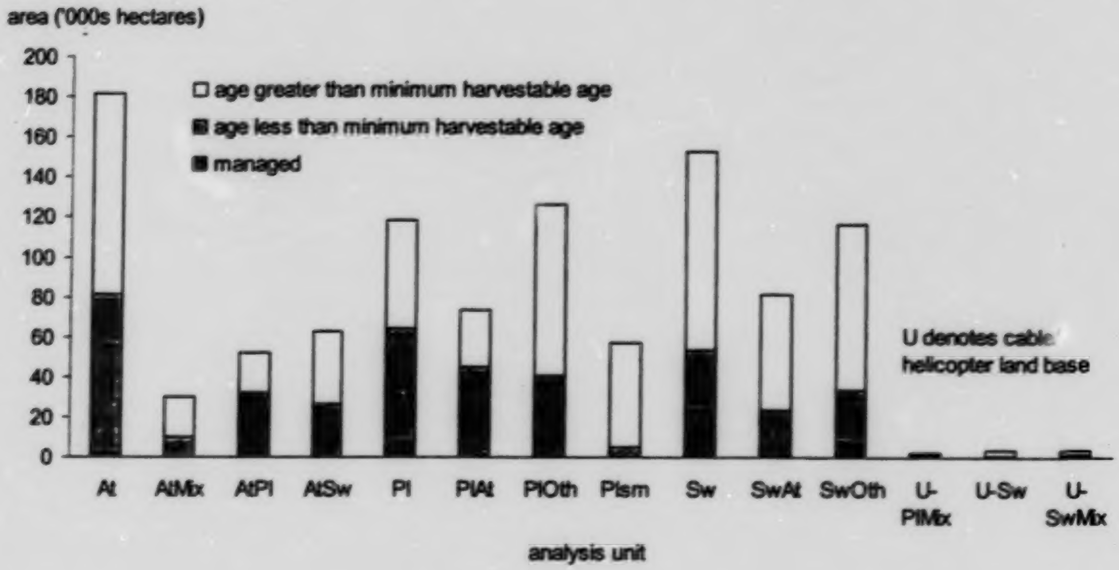

Figure 3. Timber harvesting land base by analysis unit and maturity — Fort St. John TSA, 2002.

Figure 4 shows the timber harvesting land base by generalized analysis unit and site index strata.

Stands classified as poor comprise 18% of the land base, medium stands — 51% and good stands — 31%. On average, spruce stands occupy the poorer sites and aspen stands occupy the more productive sites.

Young stands of very low productivity were excluded from the timber harvesting land base unless there was a history of harvesting. Older stands meeting a minimum volume criterion were considered available for harvest.

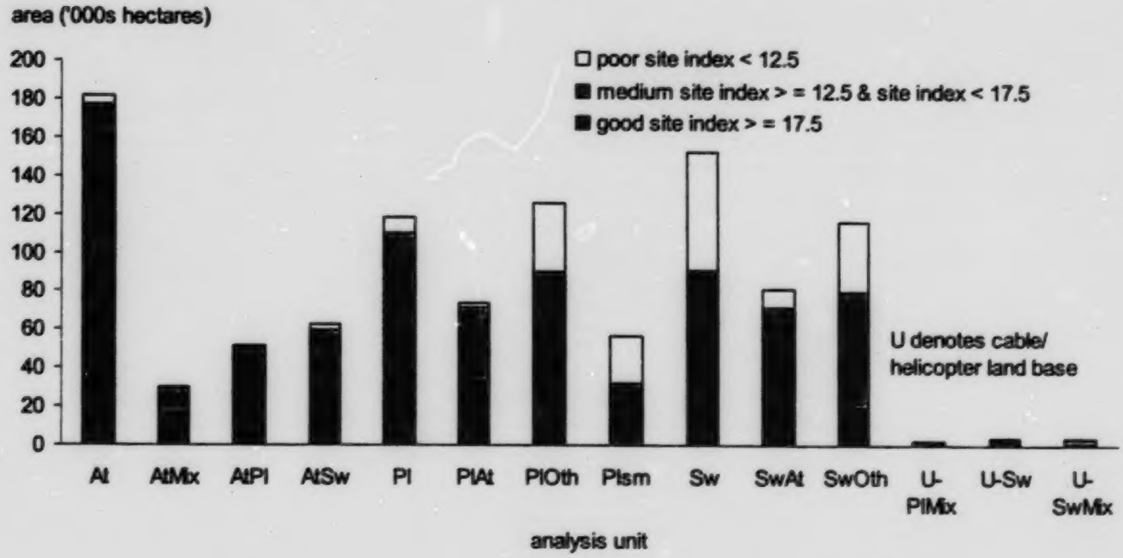

Figure 4. Timber harvesting land base by timber growing potential — Fort St. John TSA timber harvesting land base, 2002.

Figure 5 shows the current age class composition of the forested land base not available for harvesting as well as the small pine, coniferous and deciduous portions of the timber harvesting land base. Less than 1% of the timber harvesting land base is occupied by stands older than 250 years. About 11% is covered with stands 20 years or younger, 43% with stands between 21 and 100 years old, and 46% with stands between 101 and 250 years old.

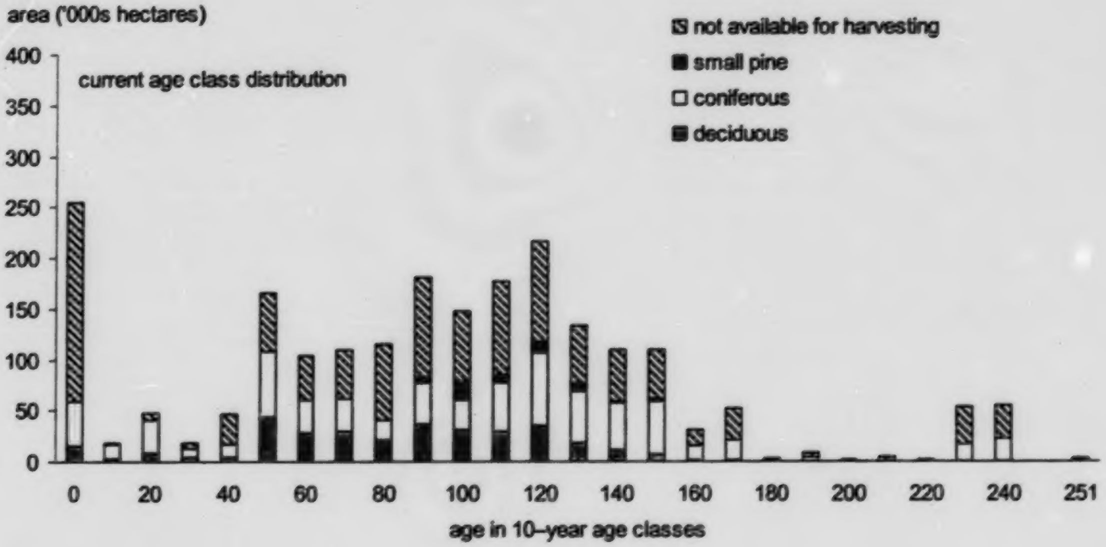

Figure 5. Current age class composition — Fort St. John TSA forested land base, 2002.

The age class distribution of forested stands excluded from the timber harvesting land base also affects timber supply. These areas can affect how much harvesting can be conducted and the pattern of the harvesting within the TSA through their ability to provide old-forest and biodiversity attributes. Less than 1% of these stands are older than 250 years. Eighteen per cent of the stands are 20 years or younger, 39% are between 21 and 100 years old, and 43% are between 101 and 250 years old.

Stands in the area that is not available for harvest change through events such as fire, heavy winds and pests. In the analysis, this natural disturbance was modelled by harvesting area (but with no contribution to volume harvested) each decade. The objective of the "harvesting" is to maintain natural proportions of forest above age 120 rather than having the forest age continuously.

2.2 Timber growth and yield

Two growth and yield models were used to estimate timber volumes for the Fort St. John TSA analysis. The variable density yield prediction (VDYP) model* developed by the Ministry of Sustainable Resource Management, Terrestrial Information Branch, was used for estimating volumes in unmanaged coniferous stands. The table interpolation program for stand yields (TIPSY)*, developed by the B.C. Forest Service, Research Branch, was used to estimate yields for coniferous managed stands. Managed stands were those harvested during the past ten to thirty years, as they are considered managed to current standards. Stands not meeting those standards are considered unmanaged.

Timber volume estimates* assume a specific utilization level, or set of dimensions, which establish the minimum sizes of trees and logs that are removed from a site. Utilization levels used in estimating timber volumes specify minimum diameters both near the base and the top of a tree as well as a maximum stump height.

Appendix A, "Description of Data Inputs and Assumptions for the Timber Supply Analysis" contains details on the definition of managed stands, utilization standards and the specific model versions used.

Volume estimation and prediction are subject to uncertainties in inventories which form the basis for estimating site productivity, limited experience with second-growth in British Columbia, and the long time frame over which trees grow. Sensitivity analyses* described in Section 5, "Timber Supply Sensitivity Analyses," address the possibility that actual timber volumes may be different from estimates used in this analysis.

Based on timber volume estimates, the current timber inventory on the timber harvesting land base is approximately 170 million cubic metres. About 154 million cubic metres, or 91% of the total, are in stands currently merchantable; that is, older than minimum harvestable age (MHA).

Variable Density Yield Prediction model
An empirical yield prediction system supported by the Ministry of Sustainable Resource Management, designed to predict average yields and provide forest inventory updates over large areas (i.e., Timber Supply Areas). It is intended for use in unmanaged natural stands of pure or mixed species composition.
Table Interpolation Program for Stand Yields
A B.C. Forest Service computer program used to generate yield projections for managed stands based on interpolating from yield tables of a model (TASS) that simulates the growth of individual trees based on internal growth processes, crown competition, environmental factors and silvicultural practices.

Volume estimates (yield projections)
Estimates of yields from forest stands over time. Yield projections can be developed for stand volume, stand diameter or specific products, and for empirical (average stocking), normal (optimal stocking) or managed stands.
Sensitivity analysis
A process used to examine how uncertainties about data and management practices could affect timber supply. Inputs to an analysis are changed, and the results are compared to a baseline or base case.

2.3 Management practices

The draft data package for the Fort St. John Timber Supply Area (TSA) was released in November 2000. As a result of public input, changes were made to the data package. The revised data package, which includes detailed descriptions of the management practices and the assumptions used to incorporate them into the analysis, is presented in Appendix A, "Description of Data Inputs and Assumptions for the Timber Supply Analysis" of this document.

Timber supply depends directly on how the forest is managed for both timber and non-timber values. Therefore, levels of management activity must be defined for the timber supply analysis process. The *Forest Practices Code of British Columbia Act* and associated regulations guide forest management practices in the Fort St. John TSA. The focus of the timber supply review is to assess timber supply based on current management practices as implemented for the area. Staff in the Fort St. John Forest District provided descriptions for the following management practices:

- Independent harvest forecasts* for the coniferous, deciduous and small pine land bases. The small pine land base consists of lodgepole pine stands that are currently greater than 80 years old and are between 17.7 and 19.4 metres in height. The coniferous and deciduous land base is comprised of aspen, subalpine fir, lodgepole pine and white spruce stands that have or will reach a height greater than 19.4 metres by age 80.
- Silviculture — reforestation activities required to establish free-growing* stands of preferred and acceptable tree species. Areas in the Fort St. John TSA are harvested using a clearcut with reserves* harvesting system and restocked by planting or natural regeneration.
- Forest health and unsalvaged losses* — unharvestable timber losses to fire and pest (insect) damage are expected to average 37 500 cubic metres per year over the 250 year analysis horizon.
- Utilization levels — minimum sizes of trees, and logs to be removed during harvesting.

Harvest forecast
The flow of potential timber harvests over time. A harvest forecast is usually a measure of the maximum timber supply that can be realized over time for a specified land base and set of management practices. It is a result of forest planning models and is affected by the size and productivity of the land base, the current growing stock, and management objectives, constraints and assumptions.

Free-growing
An established seedling of an acceptable commercial species that is free from growth-inhibiting brush, weed and excessive tree competition.

Clearcutting with reserves
A variation of the clearcut silvicultural system in which trees are retained, either uniformly or in small groups, for purposes other than regeneration.

Unsalvaged losses
The volume of timber killed or damaged annually by natural causes (e.g., fire, wind, insects and disease) that is not harvested.

- Cutblock adjacency* and green-up* — in the Fort St. John TSA, approval of harvesting activities is contingent on previously harvested stands reaching a desired condition, or green-up (three metres in height for the integrated resource management (IRM)* area), before adjacent stands may be harvested. The purpose of the cutblock adjacency guideline is to prevent timber harvesting from becoming overly concentrated in an area. This guideline was modelled by limiting the area within the IRM zone that does not meet green-up conditions to a maximum of 40%.
- Maintenance of scenic values — visible evidence of harvesting must be kept within limits in some areas of the Fort St. John TSA. The maximum proportion of each scenic area* that may be covered by young stands that do not meet visual green-up requirements (five metres in height) varies depending on the forest characteristics, the visual quality objectives (VQO)* and the visual absorption capability (VAC) for each area. The permissible area below green-up age ranges from 1% for preservation VQOs* and 33% for maximum modification VQOs*.
- Maintenance of forest cover for caribou habitat — applies to 106 868 hectares, or 11.4% of the timber harvesting land base. These areas include Graham (with a requirement to maintain a minimum of 40% greater than 140 years of age), Kobes Creek (40% greater than 120 years of age) and Hackney Hills habitat areas (40% greater than 100 years of age).

Cutblock adjacency
The desired spatial relationship among cutblocks. Most adjacency restrictions require that recently harvested areas must achieve a desired condition (green-up) before nearby or adjacent areas can be harvested. Specifications for the maximum allowable proportion of a forested landscape that does not meet green-up requirements are used to approximate the timber supply impacts of adjacency restrictions.
Green-up
The time needed after harvesting for a stand of trees to reach a desired condition (usually a specific height) — to ensure maintenance of water quality, wildlife habitat, soil stability or aesthetics — before harvesting is permitted in adjacent areas.
Integrated resource management (IRM)
The identification and consideration of all resource values, including social, economic and environmental needs, in resource planning and decision-making.

Scenic area
Any visually sensitive area or scenic landscape identified through a visual landscape inventory or planning process carried out or approved by a district manager.
Visual quality objective (VQO)
Defines a level of acceptable landscape alteration resulting from timber harvesting and other activities. A number of visual quality classes have been defined on the basis of the maximum amount of alteration permitted.
Preservation VQO
*Alterations are generally not visible. Up to 1% of the visible landscape can be visibly changed by harvesting activity. (see **Visual quality objective**).*
Maximum modification VQO
*Visible alterations are dominant and out of scale, but appear natural in the background. Up to 33% of the area can be visibly altered by harvesting activity (see **Visual quality objective**).*

- Management of caribou habitat (Milligan Hills) through cutblock adjacency — affects 120 890 hectares or 10.1% of the timber harvesting land base. The habitat is managed by utilizing a 2-pass harvesting system with 40 years between passes.
- Protection of environmentally sensitive areas — areas where sensitive soils, potential for avalanches, recreation values and forest regeneration problems have been identified. To maintain ecological or other resource values, land has been partially or entirely excluded from the timber harvesting land base.
- Minimum harvestable ages (MHAs) — the time it takes for stands to grow to a merchantable condition. Using conventional harvest systems such as "cut and skid", stands were considered merchantable when coniferous stands attained a volume of 140 cubic metres per hectare and deciduous stands attained a volume of 120 cubic metres per hectare. Where helicopter or cable logging is performed, stands were considered merchantable when they attained a volume 250 cubic metres per hectare. Actual harvest age is generally greater but never less than the minimum, and will depend on ages of other available stands, forest cover objectives* and overall timber harvest targets.
- Landscape-level biodiversity — to maintain biological diversity throughout a landscape unit, the *Forest Practices Code* specifies targets for the proportion of the area in each biogeoclimatic variant that should be covered by stands with old-forest characteristics. Landscape units and biodiversity emphasis options (BEOs) are in draft form in the Fort St. John TSA and were used to develop the base case.
- Stand-level biodiversity — to maintain biological diversity in forest stands, wildlife tree patches (WTP) are retained after harvesting. In the Fort St. John TSA, the recommended WTP retention levels were applied by landscape unit, BEC zone and coniferous or deciduous content (see Appendix A, Section A.4.4.2, "Wildlife tree patches (WTP)").

Forest cover objectives
Specify desired distributions of areas by age or size class groupings. These objectives can be used to reflect desired conditions for wildlife, watershed protection, visual quality and other integrated resource management objectives. General adjacency and green-up guidelines are also specified using forest cover objectives (see ***Cutblock adjacency*** *and* ***Green-up****).*

Figure 6 shows the total Crown forest land base by management emphasis. The overall area is 4% larger then the TSA forest because some caribou management area overlaps with some integrated resource and visual quality objective (VQO) areas. Figure 7 shows the VQO area by type. Figure 8 shows the caribou area by type.

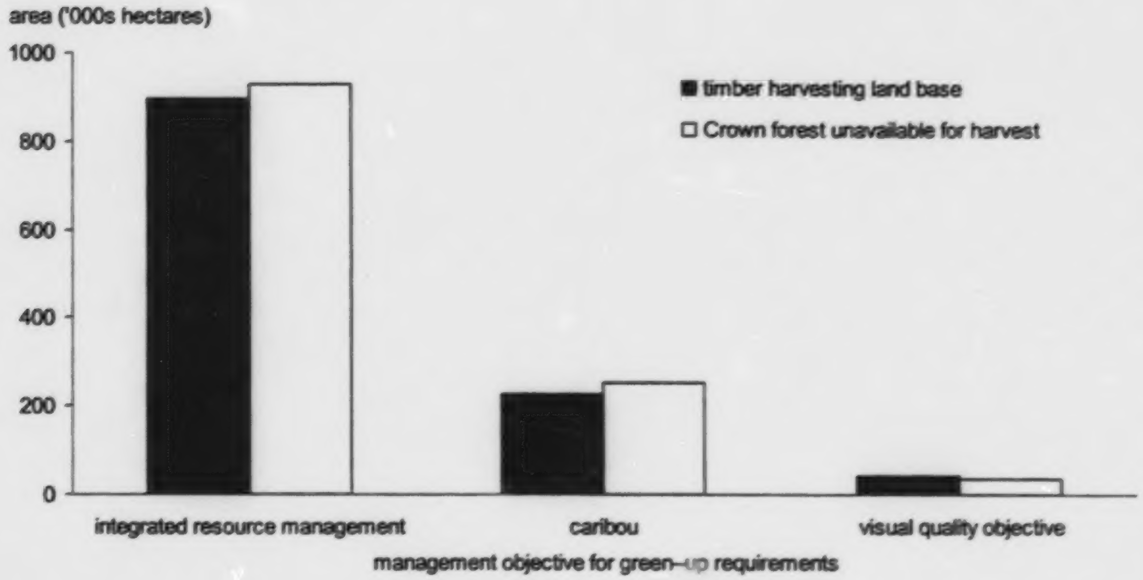

Figure 6. Crown forest land base by management emphasis — Fort St. John TSA, 2002.

Figure 7 shows the amount of area within the TSA being managed for the various visual quality objectives.

Figure 8 shows the amount of area within the TSA being managed for caribou habitat.

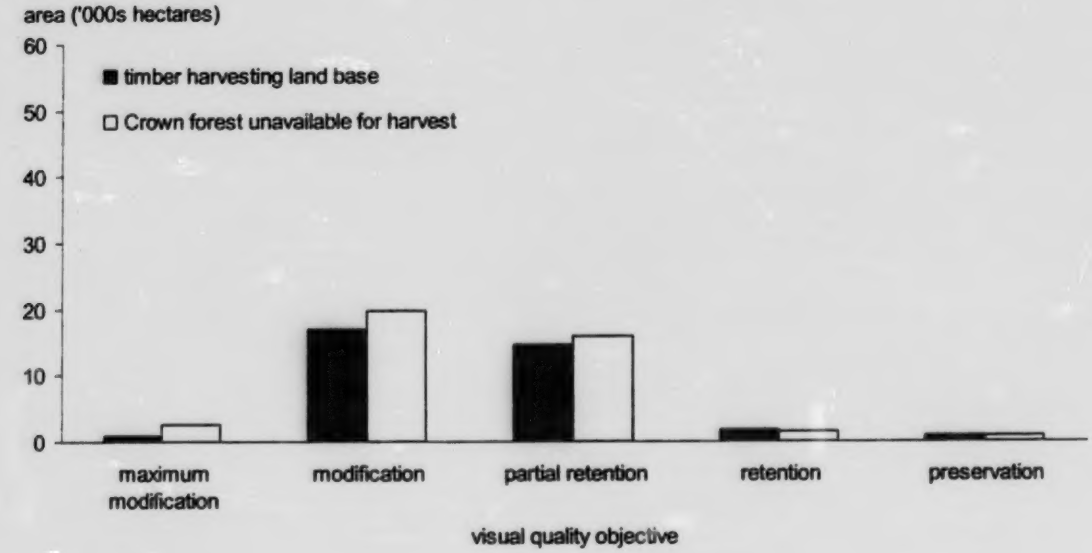

Figure 7. Area within the TSA managed by visual quality objective (VQO) in the Fort St. John TSA.

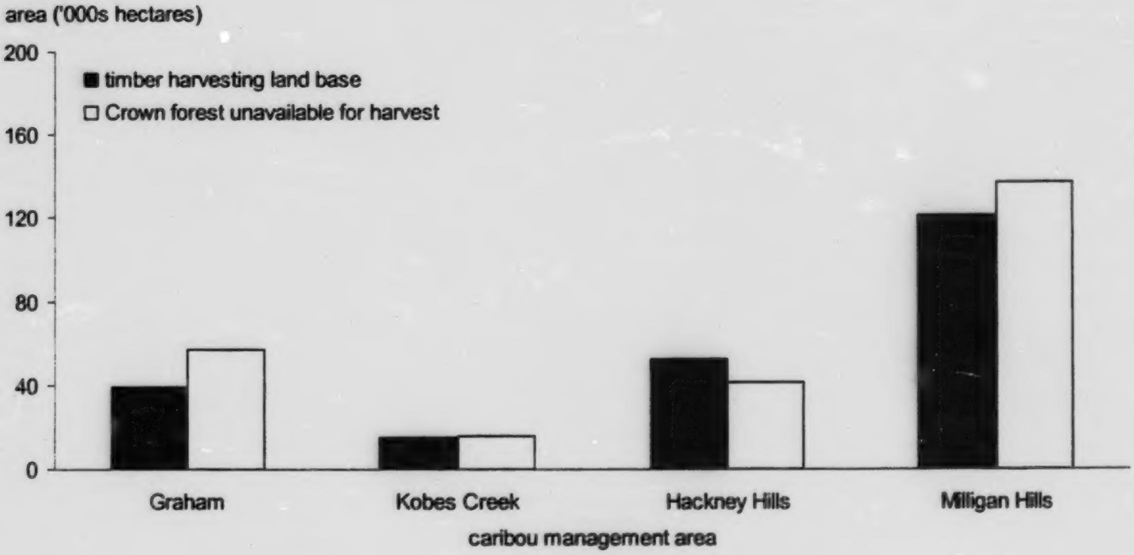

Figure 8. Area within the TSA managed for caribou habitat — Fort St. John TSA 2002.

3 Timber Supply Analysis Methods

The purpose of this analysis is apply the current forest management practices to the land base and examine the short- to long-term timber harvesting opportunities in the Fort St. John TSA. A timber supply computer simulation model developed by the B.C. Forest Service (Forest Service Simulator (FSSIM) version 4.1) was used to aid in the assessment. A timber supply model, as distinct from a growth and yield model, assists the timber supply analyst in determining how a whole forest (collection of stands) could be managed to obtain a harvest forecast (supply of timber over time). The simulation model uses information about the timber harvesting land base, timber volumes and the management regime to represent how stands will grow and be harvested over a long period of time. Generally, the results for the first 250 years are shown graphically in this report because the harvest level remains constant after that time.

Similar to other models, the B.C. Forest Service model assumes that trees grow according to provided yield projections and are harvested according to either a volume target or a specified objective set by the analyst. The Forest Service model also allows the use of forest cover guidelines that specify the desired age composition of the forest. These guidelines can be used to examine the effects of green-up and old-forest prescriptions. For example, guidelines might specify a maximum percentage of the forest that can be younger than a specified green-up age or some minimum percentage of the forest that must be in older age classes to provide wildlife habitat.

Management assumptions can be changed in the B.C. Forest Service simulation model to allow for the examination of management guidelines on timber supply. This type of analysis is used to determine the timber supply implication of a particular management regime. The results of the analysis are especially important in determining allowable cuts that will not restrict options of future resource managers, and that will assist local B.C. Forest Service staff to administer their programs according to relevant guidelines and principles. However, the results of the analysis are not meant to be taken as recommendations of any particular AAC.

The main results of the analysis are forecasts of potential timber harvests and timber inventory changes (ages and volumes) over time. Although this information gives field staff only limited guidance in the design of operational activities such as harvest block location and silviculture planning, it does help ensure that the timber harvest level supports sustainable forest management in the field.

4 Results

This section presents the results of the timber supply analysis for the Fort St. John TSA. The base case harvest forecast* uses the most recent assessments of current forest management, the land available for timber harvesting, and timber yields as described in Section 2, "Information Preparation for the Timber Supply Analysis." The impacts of uncertainty in the inputs to the analysis will be discussed in Section 5, "Timber Supply Sensitivity Analyses." The base case provides only a part of the timber supply picture for the Fort St. John TSA, and should not be viewed in isolation of the sensitivity analysis.

The previous sections have outlined changes since the 1995 Fort St. John TSA analysis. Any comparison between this and the last analysis should acknowledge differences in management regimes and related data, and assumptions made at the time of each analysis. Finally, one of the major reasons the chief forester is required under the *Forest Act* to periodically review the timber supply and AAC is to account for changes in management, information and knowledge.

4.1 Base case harvest forecast

The base case harvest forecast for the Fort St. John TSA represents current management as described in Appendix A of this report. Figure 9 shows the three components (coniferous, deciduous and small pine) which make up the base case harvest forecast.

Base case harvest forecast
The timber supply forecast which illustrates the effect of current forest management practices on the timber supply using the best available information, and which forms the reference point for sensitivity analysis.

4 Results

The current AAC for the Fort St. John TSA is 2 015 000 cubic metres (excluding woodlots). Of this AAC, 1 100 000 cubic metres are attributed to predominantly coniferous stands and 915 000 cubic metres to predominantly deciduous stands. The coniferous portion of this AAC included the contribution from small pine stands. In this analysis the contribution from the small pine component is shown separately from the coniferous component. The base case shows a harvest level of 2 719 000 cubic metres per year is possible for the first 30 years after which it gradually declines to a long-term level of 2 425 000 cubic metres per year.

The small pine component can sustain a harvest level of 110 000 cubic metres per year for 16 decades before declining to a long-term harvest level* of 99 000 cubic metres per year.

The contribution from the coniferous-leading stands is 1 694 000 cubic metres per year for the entire planning horizon. Deciduous-leading stands can maintain a harvest level of 915 000 cubic metres per year for the first three decades before declining by 10% per decade to a long-term harvest level of 632 000 cubic metres per year.

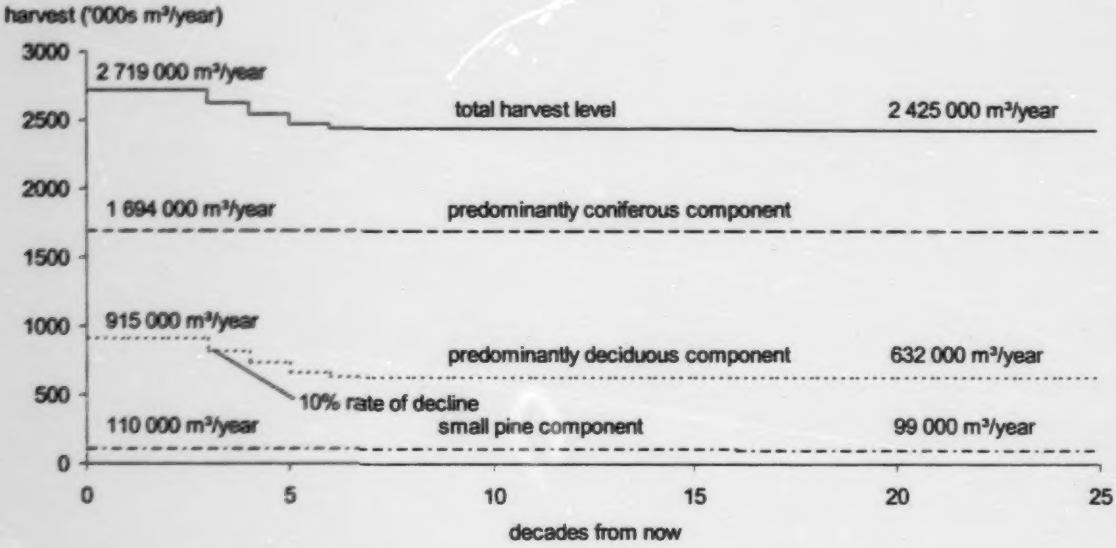

Figure 9. Base case harvest forecast — Fort. St. John TSA, 2002.

Long-term harvest level
A harvest level that can be maintained indefinitely given a particular forest management regime (which defines the timber harvesting land base, and objectives and guidelines for non-timber values) and estimates of timber growth and yield.

4.2 Base case harvest forecast assumptions and dynamics

The assumptions for developing the base case are presented in this section. Where applicable the impact of these assumptions is discussed:

- Unsalvaged losses are 37 500 cubic metres per year over the entire planning horizon.
- The base case is an amalgamation of three components: coniferous, deciduous and small pine. The timber harvesting land base associated with each of these components is:
    - small pine — 56 698 hectares;
    - conifer — 676 523 hectares;
    - deciduous (predominately aspen) — 325 318 hectares.
- Lodgepole pine contributes to two of the components. In the small pine harvest forecast the stands are greater than 80 years old and are between 17.7 and 19.4 metres in height. In the coniferous component the pine stands are greater than 80 years old and greater than 19.4 metres in height or have the potential to be greater than 19.4 metres in height by age 80.
- The deciduous component of the base case consists of predominantly aspen stands.
- Natural stand disturbance is modelled by "harvesting" on the non-timber harvesting land base.
- Many forecasts are possible for the three harvest flows shown in the base case. The criteria for selecting the base case harvest flows or patterns are:
    - For all forecasts — the current AAC is maintained for as long as possible.
    - The initial harvest level for small pine is based on the assumption that as much as 10% of the harvest could come from small pine within the current coniferous AAC.
    - The coniferous AAC of 1 100 000 cubic metres per year can be met over the entire model simulation period. At this level the growing stock* continually increases indicating a higher level of harvest is possible. Since the harvest level is greater than the current AAC, an even-flow harvest forecast has been assumed for this component of the base case.
    - The harvest forecast gives stands identified in the development plan the first priority for harvest.
    - The random harvest rule (*versus* relative oldest first) was selected to provide for the greater possibility of a dispersed harvest across the TSA. For coniferous stands the harvest rule was modified by placing priorities on certain stand types. The first harvest priority is pine stands greater than 120 years old and spruce stands greater than 140 years old. The second harvest priority is coniferous stands above culmination age*. No harvest priorities were given to the deciduous component of the base case. This reflects the operational consideration that allocations may target both young and old stands.

Growing stock
The volume estimate for all standing timber at a particular time.

Culmination age
The age at which a timber stand reaches its highest average growth rate, or mean annual increment (MAI). MAI is calculated as stand volume divided by stand age. Culmination age is the optimal biological rotation age to maximize long-term volume production from a growing site.

4 Results

- One result of using harvest priorities on the coniferous harvest flows but not the deciduous harvest flow is that coniferous stands will be targeted for harvest first. This may reduce the availability of deciduous stands since they may be required to meet forest cover considerations. Also, the harvest priorities remove some of the age related randomness and harvests trend towards older, higher volume stands.

Figure 10 shows the transition from existing unmanaged stand to managed stand harvest. Given that only 11% of the timber harvesting land base is less than 20 years old, any change that affects the timing of the transition could affect the harvest forecast.

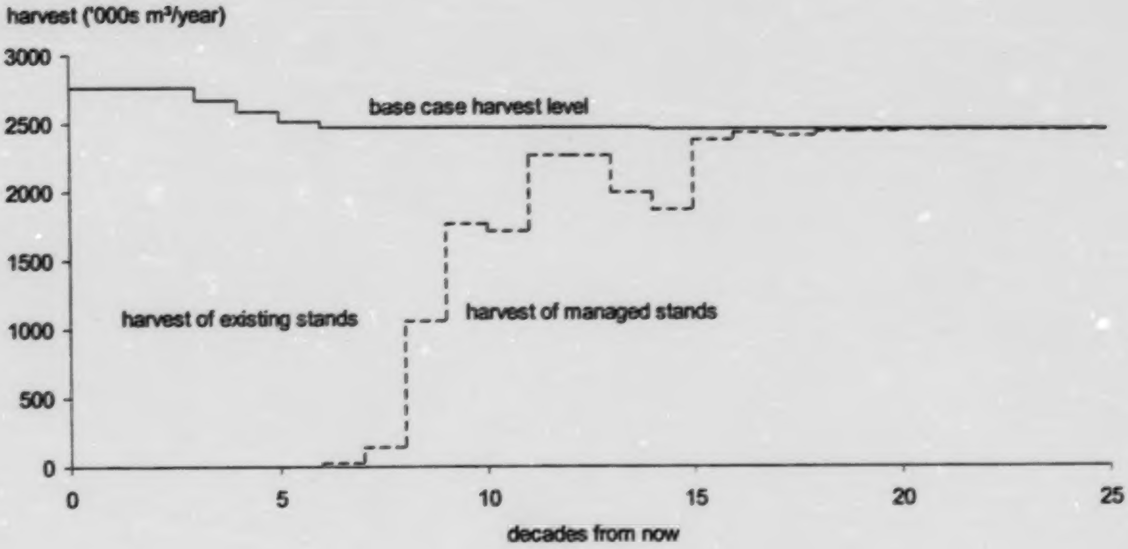

Figure 10. Harvest transition from existing to managed stands — Fort St. John TSA, 2002.

Figure 11 shows a projection of timber inventory volumes over time corresponding to the base case harvest forecast. Total growing stock on the timber harvesting land base declines over the next 10 decades from 170 million cubic metres as the older existing mature stands are harvested and replaced by younger second-growth stands. Over the long term, the average total growing stock for the base case is about 95 million cubic metres. Even though timber may be merchantable it may not be available for harvesting because the stands are required to satisfy other resource requirements, such as maintenance of scenic values, biological diversity or green-up, as defined in Appendix A. This is demonstrated by the presence of merchantable growing stock from existing stands after decade 15.

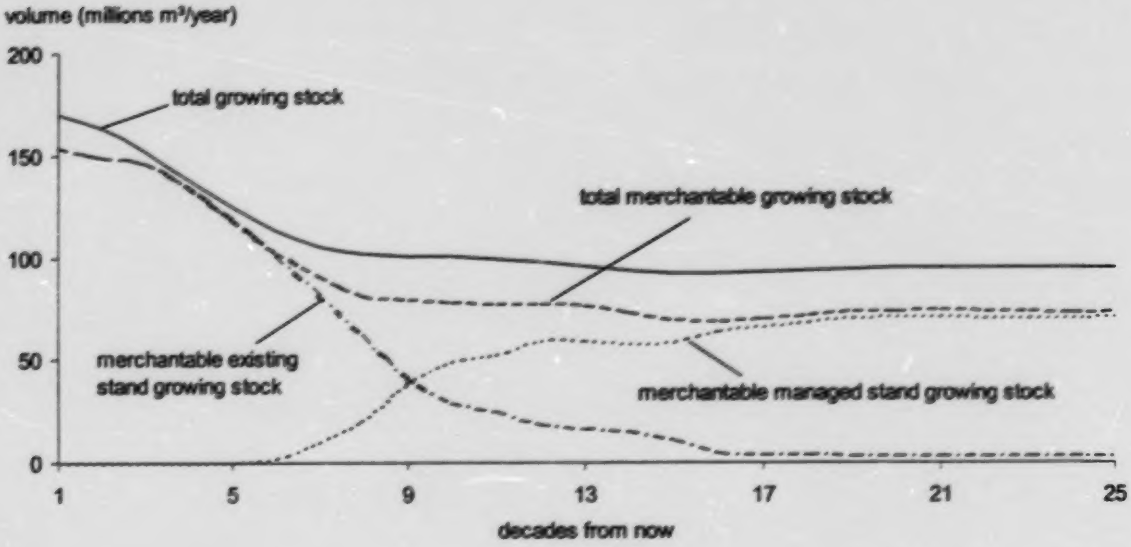

Figure 11. Total and merchantable growing stocks — Fort St. John TSA, 2002.

4 Results

Figure 12 shows the merchantable growing stock by harvest component over the 250-year planning horizon for the Fort St. John TSA. Even though the deciduous timber harvesting land base is 31% of the total, the contribution to the total growing stock is considerably less because aspen does not generate as much stand volume at older ages as coniferous species.

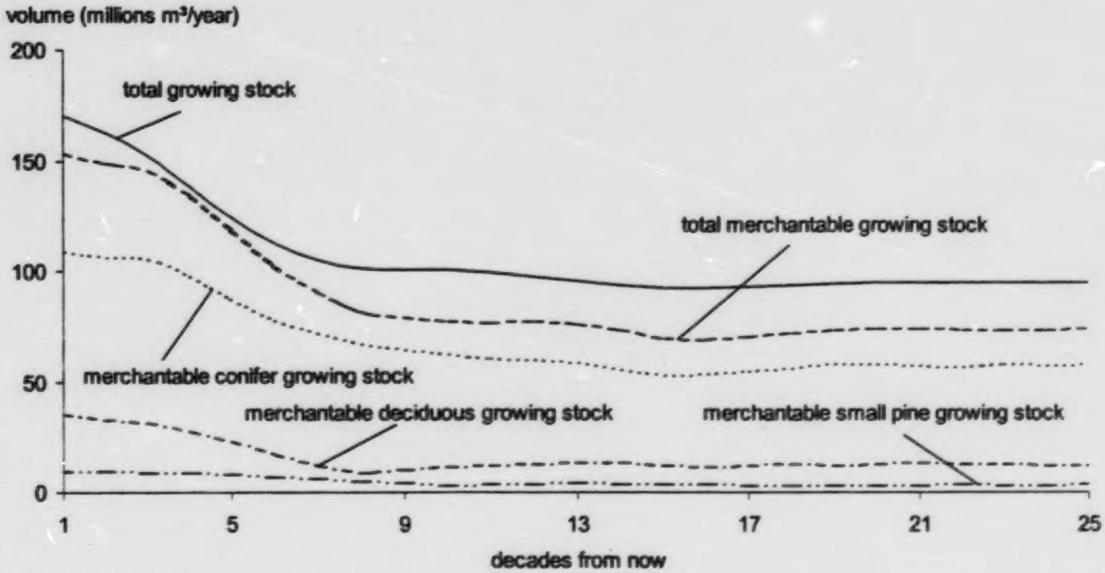

Figure 12. Total and merchantable growing stock by harvest component — Fort St. John TSA, 2002.

4.3 Area, average volume and average age harvested

Figure 13 tracks the change in the average harvest age of stands. Initially, the harvest is from stands allocated in the development plan. Thereafter, stands are allocated by merchantability, availability (in terms of forest cover requirements) and harvest priority.

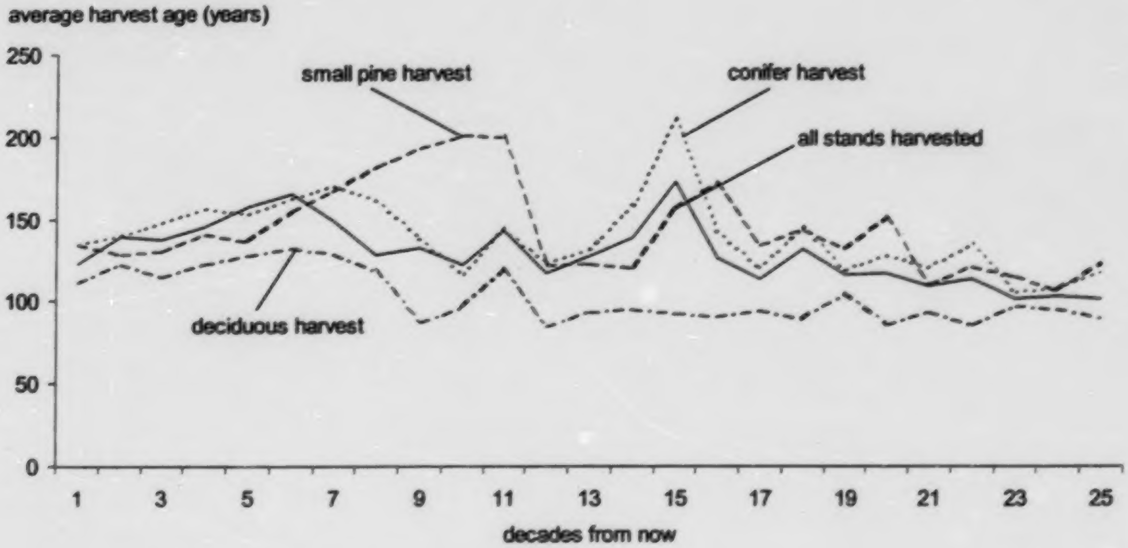

Figure 13. Average harvest age by harvest component — Fort St. John TSA, 2002.

4 Results

Figure 14 shows the average volume per hectare harvested over time for the coniferous, deciduous and small pine components of the base case.

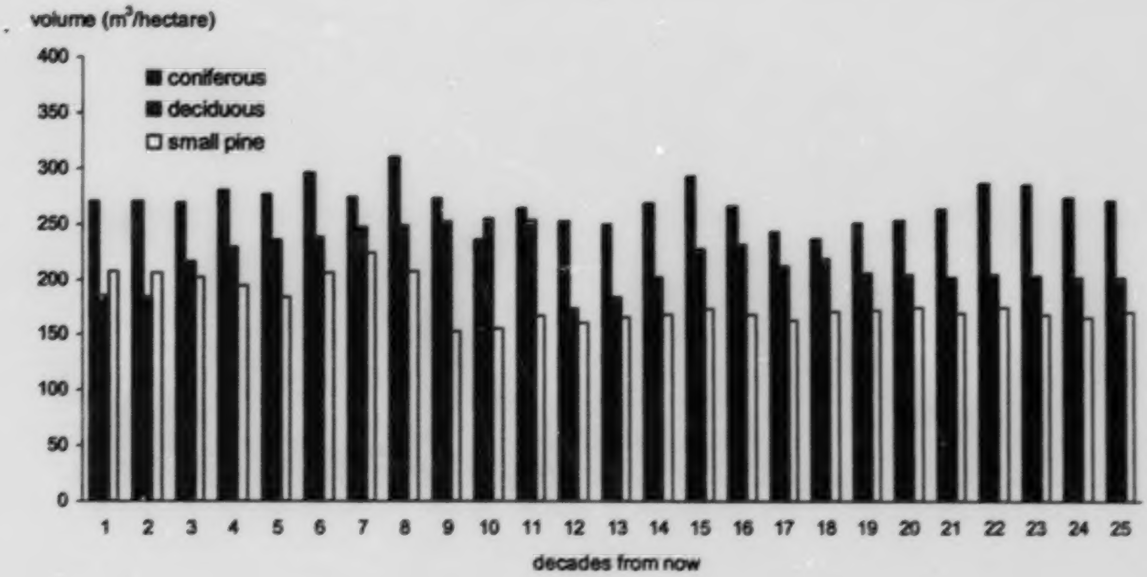

Figure 14. Average volume per hectare harvested — Fort St. John TSA, 2002.

Figure 15 shows the average area harvested over time for the coniferous, deciduous and small pine components of the base case. The average area harvested is over 10 000 hectares per year except during decades six, seven and eight, when the remaining existing stands have higher volumes and less area must be harvested to achieve the same total volume harvested.

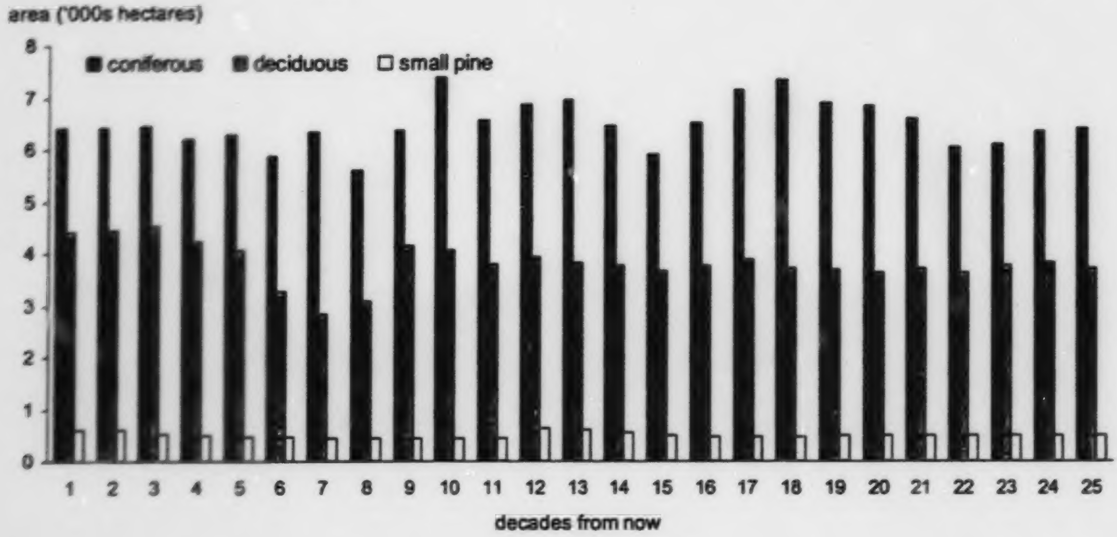

Figure 15. Average area harvested — Fort St. John TSA, 2002.

4.4 Age class profile over time

The charts in Figure 16 show how the age composition of the Fort St. John TSA productive forest land base changes over the next 250 years under the base case harvest forecast.

There are approximately 2 243 300 hectares of productive forest land base within the Fort St. John TSA analysis area, of which 1 058 500 hectares (47%) make up the initial timber harvesting land base. The initial age class distribution illustrates a number of historical events and management practices.

- A large amount of the non-timber harvesting land base is shown as age zero. This represents non-recoverable NSR and wildlife burn areas, utility corridors, roads, non-commercial brush and range management areas;
- Most of the timber harvesting land base is between 30 and 170 years of age due to large wildfires that occurred when there were no protection measures; and
- A small amount of area is greater than 200 years of age (in ecosystems with low-intensity fires) (NDT 4).

Under current management assumptions, the age class distribution for the timber harvesting land base becomes more evenly distributed over time.

The land base that is not available for timber harvesting does not age indefinitely as stand initiating events such as fire and endemic-level pests are simulated through area control harvesting. The objective is to maintain approximately 50% of the non-timber harvesting land base younger than 120 years of age.

Range and wildlife burn areas that are not available for timber harvesting are maintained between the ages of 30 and 60 years (and do not contribute to forest cover requirements).

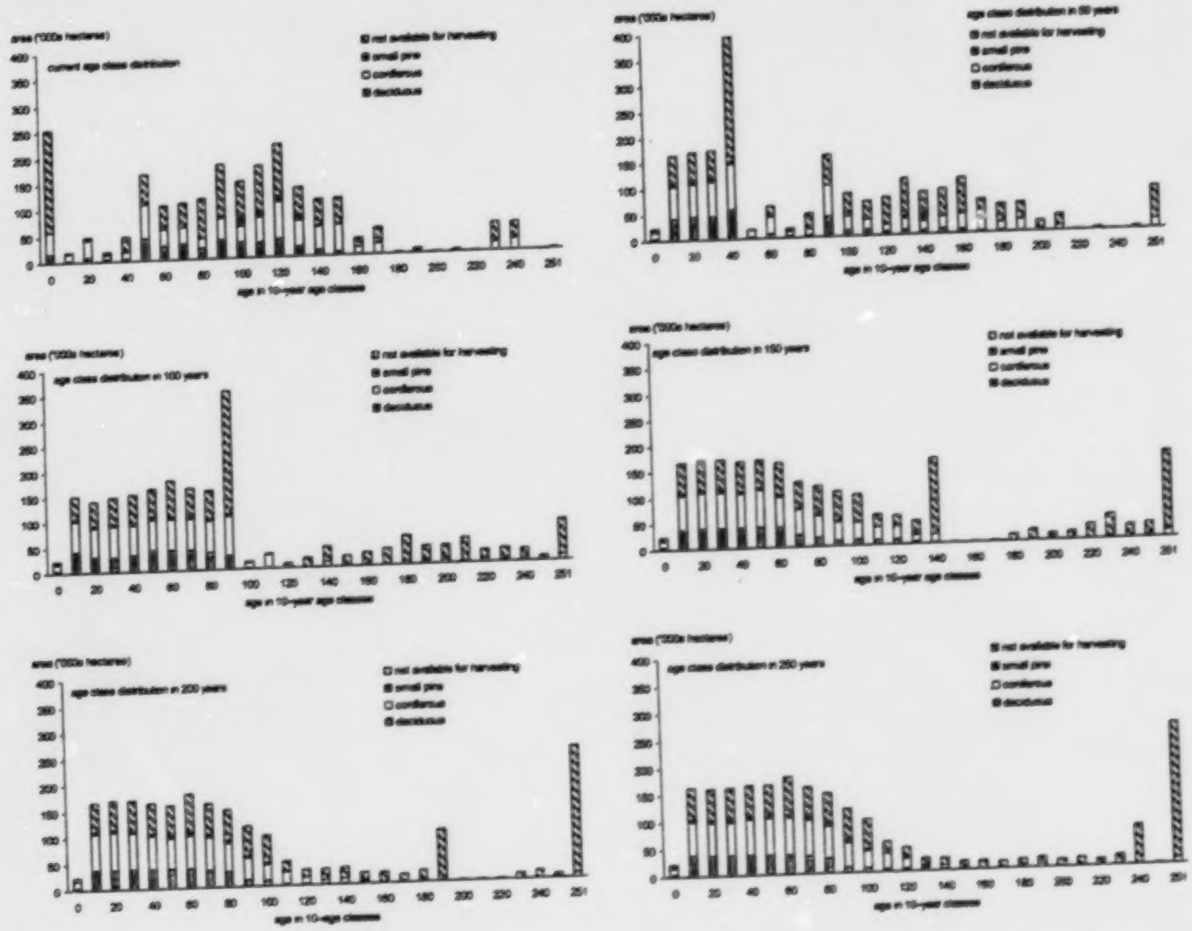

Figure 16. Changes in age composition on the productive land base over time — Fort St. John TSA base case, 2002.

5 Timber Supply Sensitivity Analyses

The best available information on forest inventories and management practices is used to analyse the timber supply implications of continuing with current management. However, forest management is complicated since it must account for diverse and changing human values, the dynamics of complex ecosystems, and fluctuating and uncertain economic factors. As well, forests grow quite slowly in terms of human time spans, so that decisions we make today have not only short-term but also long-term effects beyond the life spans of current decision makers. In such a context, we cannot be certain that all the data accurately reflect the current state of all values in the forest, how the forest will change, or how our management activities will affect the forest.

One important way to deal with this uncertainty is to revise plans and analyses frequently to ensure they incorporate up-to-date information and knowledge. Frequent planning and decision-making can help minimize any negative effects that may occur if decisions are based on inaccurate information. Frequent revision can also ensure that opportunities that become apparent from new information are not missed.

Another important way of dealing with uncertainty is to assess how values of interest, (for example, timber supply), could change if the *information used in the analysis is not accurate.* Sensitivity analysis is one way of evaluating how uncertainty could affect analysis results, and ultimately decision-making. Sensitivity analysis can highlight that fairly small uncertainties about some variables could have large effects on timber supply projections, or conversely that fairly large inaccuracies in other variables could have negligible effects. Also, sensitivity analysis could show that some variables affect timber supply more in the short-term than in the long-term, while others have the opposite effect. Sensitivity analysis can highlight priorities for collecting information for future analyses, and show which variables, and associated uncertainties, have the most significance for decisions. It can clarify whether current best estimates provide a safe basis for decisions, or whether high uncertainty about important variables means more conservative decisions may be wiser.

In this section, results of a number of sensitivity analyses are discussed. Sensitivity analyses are intended primarily to test the relative change (i.e., high *versus* low sensitivity) in the harvest forecast resulting from changes in forest management assumptions and data used in the base case. Short-term refers to the first 20 years of the harvest forecast, medium-term is 21 to 100 years from now, and long-term is after 100 years from now.

5 Timber Supply Sensitivity Analyses

5.1 Alternative harvest forecasts

The base case harvest forecast shown in Figure 9 was developed subject to several assumptions discussed in Section 4.1, "Base case harvest forecast." Other forecasts are possible and examples are provided in this section.

Figures 17 and 18 compare two alternative forecasts with the base case. The first examines the impact of increasing the initial coniferous harvest by 10% for 10 years and the second examines increasing the initial small pine and deciduous harvests for ten or more years. All inputs related to land base, growth and yield and management in these analyses are the same as those used in the base case. A longer planning horizon is shown in the figures to show when timber supply impacts occur.

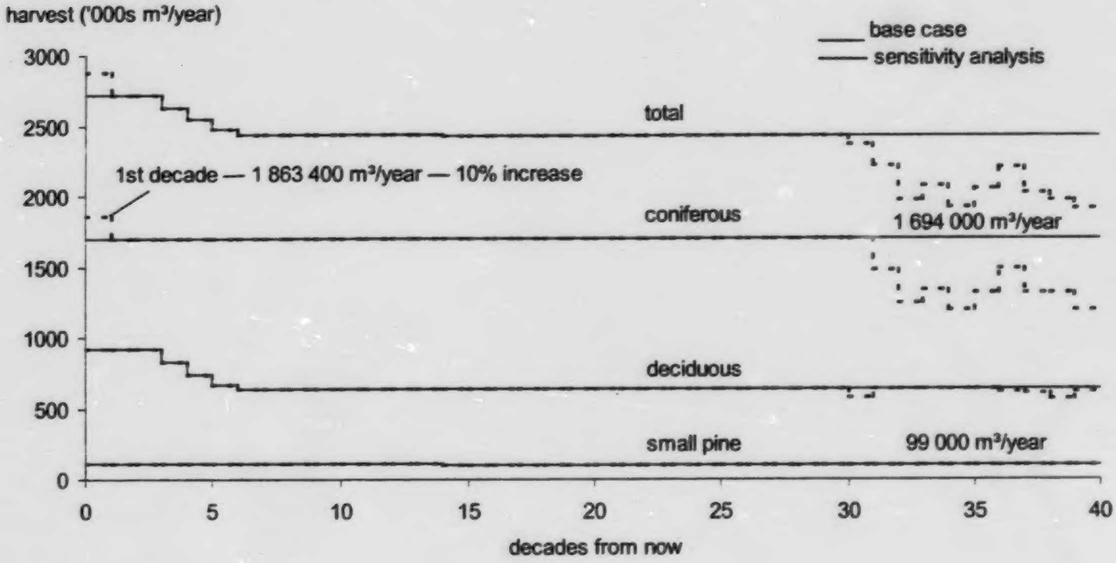

Figure 17. Increase initial coniferous harvest by 10% — Fort St. John TSA, 2002.

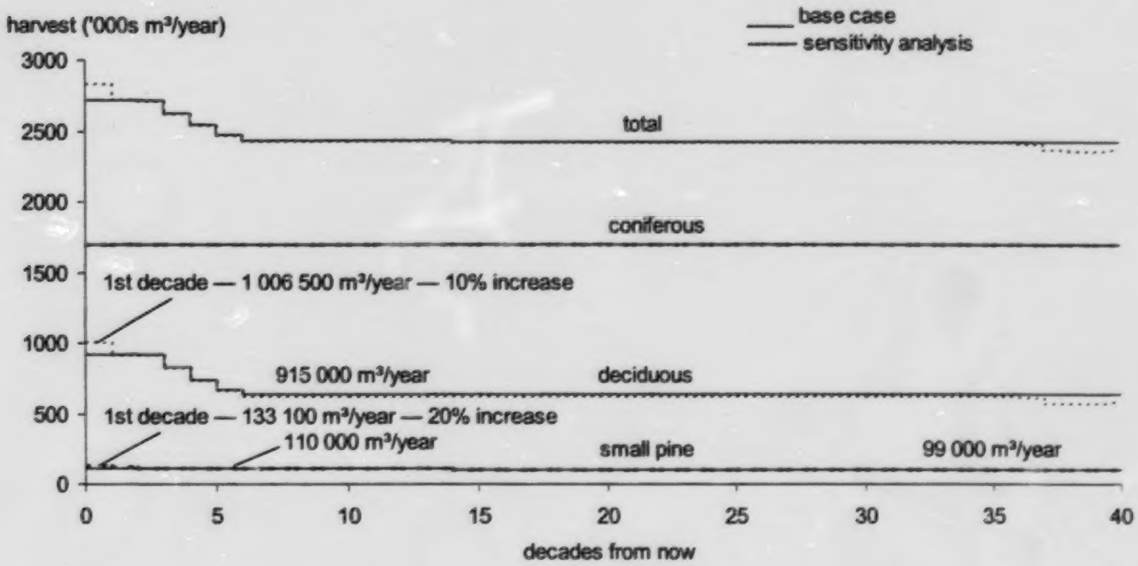

Figure 18. Increase initial deciduous harvest by 10% and small pine harvest by 20% — Fort St. John TSA, 2002.

Increase current coniferous harvest level

It is not possible to increase the current coniferous harvest level for one decade by 10% to 1 863 400 cubic metres per year without causing future timber supply disruption. This higher rate of harvest is achieved by harvesting the existing inventory of mature timber more rapidly. While mid-term timber supply can be maintained, in the very long-term, the second crop of managed stands is not merchantable in time for harvest. This sensitivity analysis may have signified that the long-term base case coniferous harvest is overestimated. However, the base case planning horizon was extended to 800 years and results show the long-term timber supply is stable.

Increase current small pine and deciduous harvest levels

The small pine harvest was increased by 20% (133 100 cubic metres per year) for the first decade and 10% (122 000 cubic metres per year) for the second decade. This harvest level could be maintained without any impact to mid- or long-term timber supply. The deciduous harvest level was increased by 10% (1 006 500 cubic metres per year) which resulted in a small decrease in mid- and long-term timber supply (2000 cubic metres per year). In the very long term (about 300 years from now), timber supply is about 30 000 cubic metres per year lower for a 50-year period. As is the case with the coniferous-leading stands, this timber shortage is a result of harvesting the existing mature timber more quickly than in the base case. Further analysis was conducted to confirm that the long-term deciduous harvest shown in the base case is indeed stable and sustainable.

5.2 Uncertainty in the harvest priorities and harvest rule assumptions

Harvest priorities

In the base case, the random harvest rule used was modified so that spruce stands over age 140 years and pine stands over age 120 years are harvested first, followed by stands over their respective culmination ages. There were no harvest priorities for deciduous-leading stands. The effect of removing these harvest priorities is shown in Figure 19.

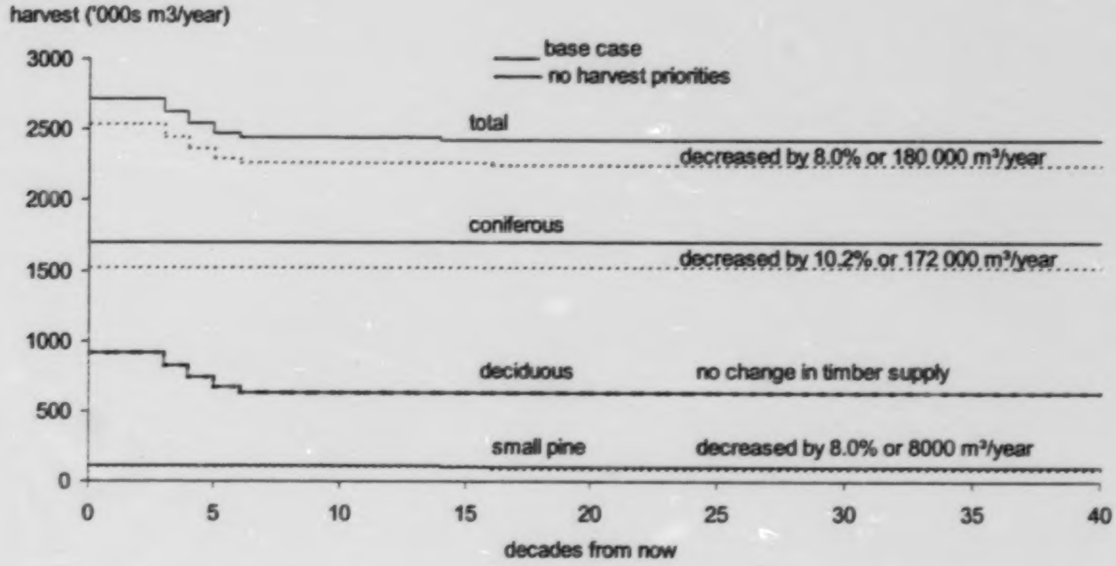

Figure 19. No harvest priorities — Fort St. John TSA, 2002.

If the base case assumptions are incorrect then coniferous harvest levels would have to be reduced by as much as 10% for the harvests to be sustainable.

Harvest rule

The relative oldest first harvest rule uses another method for allocating stands to be harvested. Using this rule, stands that have the greatest difference between the current age and their minimum harvestable age have the highest priority for harvesting. Figure 20 shows the effect on timber supply when the relative oldest first harvest rule is applied.

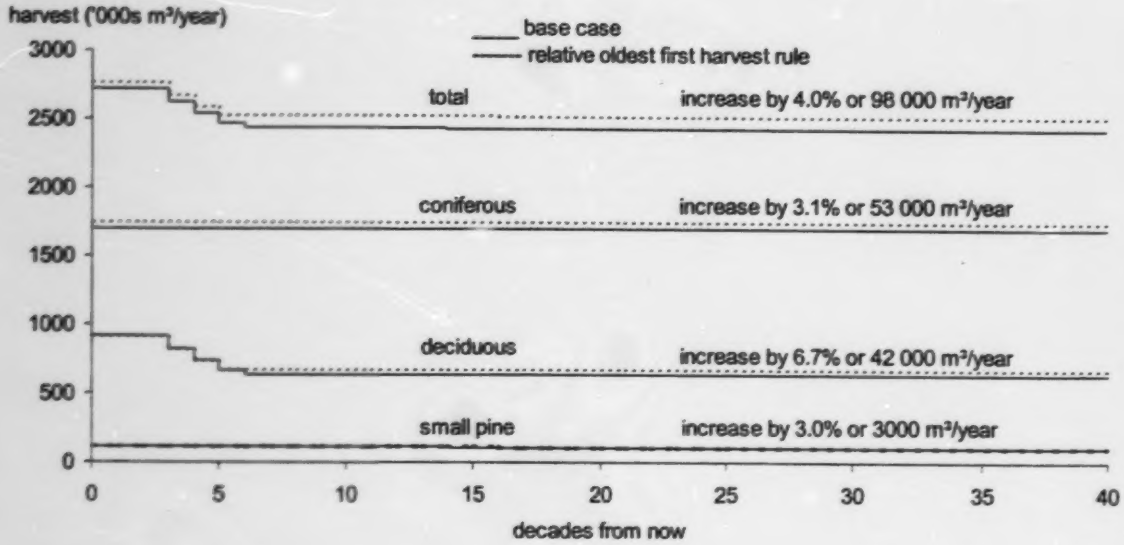

Figure 20. Relative oldest first harvest rule — Fort St. John TSA, 2002.

Timber supply is only slightly sensitive to the change in the harvest rule, mainly because the random harvest rule used in the base case was modified to target some older stands. In reality, short-term road construction and transportation costs may be too high to allow for the application of the relative oldest first rule.

5.3 Uncertainty in the rate of natural disturbance on the non-timber harvesting land base

To model long-term average rate of natural disturbance in the non-timber harvesting land base, procedures outlined in Appendix 4 of the *Biodiversity Guidebook* were used. In the base case, an area harvest is used to ensure that no more than 50% of the non-timber harvesting land base is over 120 years of age. To evaluate the impact of this assumption on the timber supply, a sensitivity analysis was performed where no measures were applied to model natural disturbance in these stands. Table 5 shows the effect of allowing the forest in the non-timber harvesting land base to age indefinitely.

Table 5. Impacts of allowing stands on the non-timber harvesting land base to age indefinitely — Fort St. John TSA, 2002

Harvest forecast	Initial harvest (m^3/year)	Volume change from base case (m^3)	Per cent change from base case (%)	Change in decades for the decline	Long-term harvest (m^3/year)	Volume change from base case (m^3)	Per cent change from base case (%)
Coniferous	1 716 000	26 000	1.5	Nil	1 716 300	26 000	1.5
Small pine	110 000	Nil	Nil	(1)	101 000	2 000	2.0
Deciduous	915 000	Nil	Nil	Nil	620 000	(12 000)[a]	(1.9)
Total	2 745 000	26 000	1.0		2 441 300	16 000	0.7

(a) The loss is attributable to the deciduous forecast having no harvest priority.

Stand disturbance on the non-timber harvesting land base has a negligible impact on timber supply in the Fort St. John TSA.

5.4 Uncertainty in the land base available for timber harvesting

Uncertainty in the estimated size of the timber harvesting land base results from factors such as fluctuations in timber prices, changes in harvesting and milling technology and land-use decisions.

The current timber harvesting land base is 11% smaller since the last timber supply analysis for the Fort St. John TSA. Less area is available due to new parks and revised low productivity criteria. However, additional areas are available due to revised operability criteria.

Currently, there is no indication that the timber harvesting land base has been over- or underestimated. However, sensitivity analysis was performed to provide general information that might help evaluate the implications of any new information that may become available before the AAC determination.

5 Timber Supply Sensitivity Analyses

Figure 21 shows the impact of re-assigning 10% of the timber harvesting land base to areas not available for harvesting. The results indicate that the short- to long-term timber supply is very sensitive to additional reductions in timber harvesting land base.

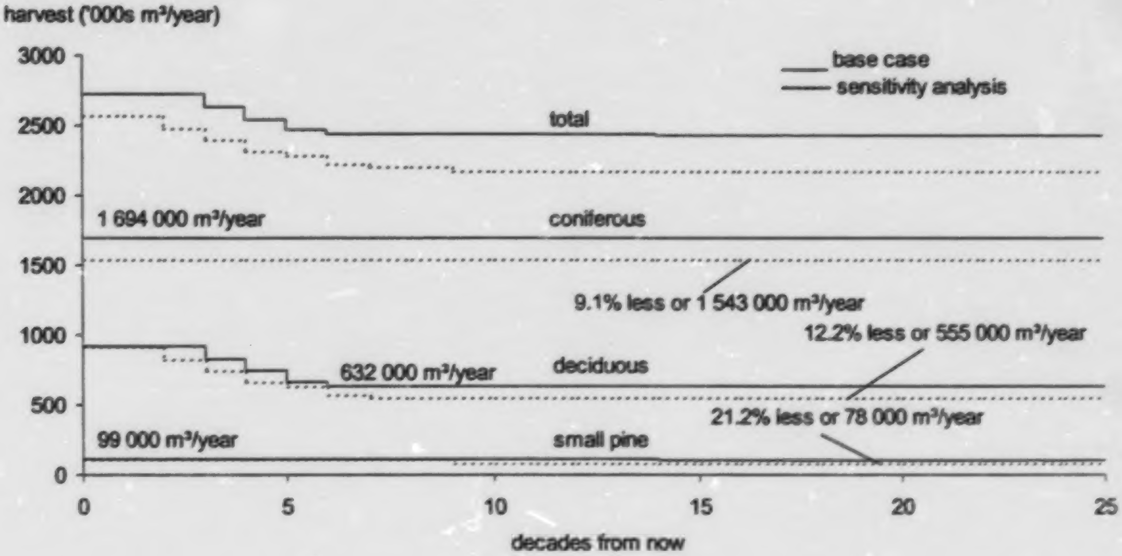

Figure 21. Impacts of a 10% reduction in the timber harvesting land base — Fort St. John TSA, 2002.

Aspen land base

Forest District staff have noted some uncertainty about harvesting approximately 62 000 hectares of aspen stands in the north-east portion of the TSA (timber supply Block F). The uncertainty stems from economic feasibility factors such as transportation costs and merchantability (isolation and value of stands). A sensitivity analysis was performed to assess the impact of removing these stands from the timber harvesting land base. Figure 22 shows the results of the analysis.

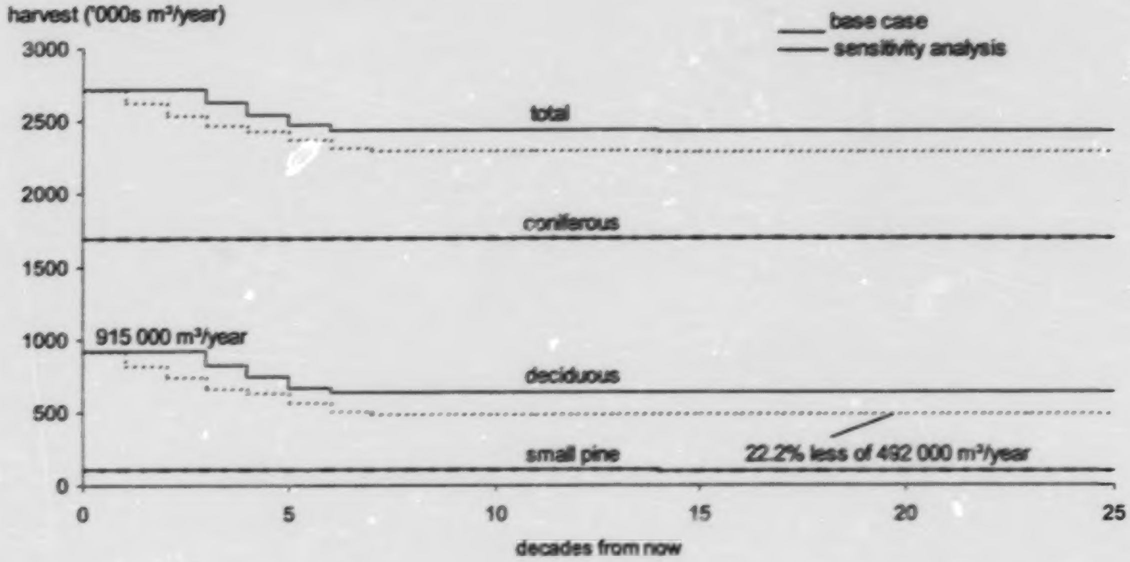

Figure 22. Economic uncertainty of harvesting aspen in the north-east portion of the TSA — Fort St. John TSA, 2002.

If timber supply Block F is removed from the timber harvesting land base, the initial deciduous harvest can maintained for one decade before it must be reduced. The harvest continues to decrease to a level that is 22.2% below the base case long-term level.

Cable/helicopter timber harvesting land base

Currently there are 9481 hectares in the coniferous timber harvesting land base that require cable or helicopter logging systems. While harvesting on more difficult terrain necessitates the more costly unconventional harvest systems, higher merchantability standards (e.g., 250 cubic metres per hectare) make this economically feasible. A sensitivity analysis was performed to assess the impact of removing cable/helicopter areas from the timber harvesting land base. Table 6 shows the results of this analysis.

Table 6. The impacts of removing unconventional harvest areas from the timber harvesting land base — Fort St. John TSA, 2002

Harvest forecast	Initial harvest (m^3/year)	Volume change from base case (m^3)	Per cent change from base case (%)	Change in decades for the decline	Long-term harvest (m^3/year)	Volume change from base case (m^3)	Per cent change from base case (%)
Coniferous	1 648 500	(45 500)	(2.7)	Nil	1 648 500	(45 500)	(2.7)
Small pine	110 000	Nil	Nil	Nil	99 000	Nil	Nil
Deciduous	915 000	Nil	Nil	Nil	632 000	Nil	Nil
Total	2 673 500	45 500)	(2.7)		2 379 500	(45 500)	(2.7)

The removal of unconventional (cable/helicopter) stands from the timber harvesting land base results in a small decrease in the even-flow coniferous harvest level.

5.5 Uncertainty in the agricultural land reserve land base

In the Fort St. John TSA, approximately 149 000 hectares of the timber harvesting land base is designated as agricultural land reserve (ALR). Historically, this area has been part of the TSA area available for harvesting and once harvested, it is regenerated for the production of timber. Forest District staff advise that regeneration to timber is current practice and the base case modelled that assumption.

During the estimation of the timber harvesting land base, district staff noted that approximately 30 000 hectares of the timber harvesting land base was designated as ALR productive forest (ownership code 62-C) but was not part of the provincial forest. While this area is believed to be part of the timber harvesting land base, a sensitivity analysis was performed to evaluate the impact of removing this area from the land base available for timber harvesting. Table 7 shows the results of this sensitivity analysis.

Table 7. Agricultural land reserve land base sensitivity analysis — Fort St. John TSA, 2002

Harvest forecast	Initial harvest (m^3/year)	Volume change from base case (m^3)	Per cent change from base case (%)	Change in decades for the decline	Long-term harvest (m^3/year)	Volume change from base case (m^3)	Per cent change from base case (%)
Coniferous	1 675 000	(19 000)	(1.1)	Nil	1 675 000	(19 000)	(1.1)
Small pine	110 000	Nil	Nil	Nil	9 000	(9 000)	(9.1)
Deciduous	915 000	Nil	Nil	(1)	592 000	(40 000)	(6.3)
Total	2 700 000	(19 000)	(0.7)		2 176 000	(68 000)	(2.8)

5.6 Uncertainty in existing stand volume estimates — the 1995 inventory audit

Timber volume estimates for existing unmanaged stands are subject to uncertainties in the forest inventory used to estimate timber volumes (i.e., estimated tree heights and stand ages), and the statistical process used to develop the equations for predicting forest growth and yield. Timber volumes are normally accurate when averaged over large areas, but may not reflect actual volumes within individual stands. Uncertainty may also arise in the estimates of volume lost to decay in older trees, of waste and breakage during harvest, and of the utilization levels practiced during harvesting. In this section a number of factors affecting uncertainty in existing stand volumes are considered.

Inventory audit

During the last several years, inventory audits have been performed for timber supply areas (TSAs) and tree farm licences (TFLs)* across the province. These audits provide an indication of how confident we can be in estimated volumes in the management unit. For the Fort St. John TSA, the Ministry of Forests released the results from an inventory audit in 1995 indicating that the average mature timber volumes for the entire TSA were 23% less than estimated from the inventory. In the chief forester's 1996 AAC determination for the Fort St. John TSA he noted that the "TSA should be examined to determine specific sources of error, and additional sampling be undertaken to validate or correct the audit finding." Additional sampling and analysis is underway as part of the vegetation resource inventory for the TSA. The analysis and inventory are expected to be released in early 2003.

As part of this analysis the original audit sample plots were re-examined. When the plots for non-merchantable species and low productivity stands were excluded, the number of plots was reduced from 38 to 30 and the overestimation was reduced from 23% to 8.2%.

Standard sensitivity analysis

Given the uncertainties in existing stand volumes, the impacts of increasing and decreasing existing unmanaged or natural stand yields (yield curves created through VDYP) by 10% were assessed. Table 8 and Table 9 show the results of this assessment.

Tree farm licence (TFL)
Provides rights to harvest timber, and outlines responsibilities for forest management, in a particular area.

Table 8. The effect on the harvest forecast of increasing existing volume estimates by 10% — Fort St. John TSA, 2002

Harvest forecast	Initial harvest (m^3/year)	Volume change from base case (m^3)	Per cent change from base case (%)	Change in decades for the decline	Long-term harvest (m^3/year)	Volume change from base case (m^3)	Per cent change from base case (%)
Coniferous	1 694 000	Nil	Nil	Nil	1 694 000	Nil	Nil
Small pine	110 000	Nil	Nil	6	99 000	Nil	Nil
Deciduous	915 000	Nil	Nil	1	632 000	Nil	Nil
Total	2 719 000	Nil	Nil		2 425 000	Nil	Nil

The analysis shows that if existing stand volumes are increased by 10%, the small pine harvest can be maintained for six decades longer. The increased volumes are insufficient to increase the coniferous harvest levels over the entire planning horizon. The increase in existing stand volumes is sufficient to allow for the maintenance of the initial deciduous harvest level for one more decade.

Table 9. The effect on the harvest forecast of decreasing existing volume estimates by 10% — Fort St. John TSA, 2002

Harvest forecast	Initial harvest (m^3/year)	Volume change from base case (m^3)	Per cent change from base case (%)	Change in decades for the decline	Long-term harvest (m^3/year)	Volume change from base case (m^3)	Per cent change from base case (%)
Coniferous	1 596 000	(98 000)	(5.8)	Nil	1 596 000	(98 000)	(5.8)
Small pine	110 000	Nil	Nil	Nil	95 000	(4 000)	(4.0)
Deciduous	915 000	Nil	Nil	(2)	619 000	(13 000)	(2.1)
Total	2 621 000	(98 000)	(3.6)		2 427 000	(115 000)	(4.7)

The analysis shows that if existing stand volumes are underestimated, the short-term coniferous harvest is reduced by 98 000 cubic metres per year (6.8%) and the initial harvest level for deciduous stands can only be maintained for 10 years. All harvest forecasts are slightly affected in the long term.

Aspen volume estimation

Estimation of aspen/cottonwood volume in pure and mixed-wood stands is an ongoing concern for Ministry of Forests staff. Current projects to improve the prediction of these volumes include the calibration of two growth and yields models (Prognosis B.C. and mixed-wood growth model (MGM)). Recently, the VDYP model provides the best available volume* information for use in this analysis.

- Currently there is no quantifiable documentation of the over- or underestimation of existing aspen stand volumes for the Fort St. John TSA. Results from the Dawson Creek TSA inventory audit applied in conjunction with the recent Phase-II Vegetation Resource Inventory analysis show aspen/cottonwood volumes may be underestimated by as much 27%. Using this estimate for guidance only, sensitivity analysis was undertaken to show the effect of increasing aspen volumes in the deciduous analysis units by 20% and 40%. For predominantly aspen analysis units the volumes were increased by the full amount. For aspen dominated mixed-wood stands, the volume increase was adjusted to reflect aspen content. Minimum harvestable ages were revised to reflect the adjusted volume tables. The results are shown in Table 10 and Table 11.

Table 10. The effect on the harvest forecast of increasing aspen analysis unit volumes by 20% — Fort St. John TSA, 2002

Harvest forecast	Initial harvest (m^3/year)	Volume change from base case (m^3)	Per cent change from base case (%)	Change in decades for the decline	Long-term harvest (m^3/year)	Volume change from base case (m^3)	Per cent change from base case (%)
Coniferous	1 694 000	Nil	Nil	Nil	1 694 000	Nil	Nil
Small pine	110 000	Nil	Nil	Nil	95 000	Nil	Nil
Deciduous	915 000	Nil	Nil	10	721 000	89 000	14.1
Total	2 719 000	Nil	Nil		2 514 000	89 000	3.7

Available volumes
The portion of total inventory volumes that is available for harvesting after all management constraints on timber harvesting have been considered, including definition of the timber harvesting land base, age of tree merchantability, deferrals, and any other priorities or constraints on timber harvesting.

Table 11. The effect on the harvest forecast of increasing aspen analysis unit volumes by 40% — Fort St. John TSA, 2002

Harvest forecast	Initial harvest (m^3/year)	Volume change from base case (m^3)	Per cent change from base case (%)	Change in decades for the decline	Long-term harvest (m^3/year)	Volume change from base case (m^3)	Per cent change from base case (%)
Coniferous	1 694 000	Nil	Nil	Nil	1 694 000	Nil	Nil
Small pine	110 000	Nil	Nil	Nil	95 000	Nil	Nil
Deciduous	915 000	Nil	Nil	21	775 000	143 000	22.6
Total	2 719 000	Nil	Nil		2 568 000	143 000	5.9

The sensitivity analyses show that uncertainty in aspen volumes has a mid- to long-term impact on timber supply. The amount of increase reflects the amount of aspen content in the adjusted volume tables. Results from the MGM or the Prognosis B.C. models should bring greater certainty to deciduous volume estimation in future timber supply reviews.

5.7 Uncertainty in managed stand volume estimates

Uncertainty in volume estimates for managed stands exists for the same reasons listed for estimated existing stand yields (inaccuracies in the forest inventory and the growth and yield models), but also because of the limited experience and data that are available for regenerated managed stands in B.C. In this section, the timber supply effects of uncertainty associated with predicting volumes in regenerated stands is examined.

Table 12 and Table 13 show the harvest forecasts that result when managed stand volumes are increased and decreased by 10%.

Table 12. The effect on the harvest forecast of increasing managed stand yields by 10% — Fort St. John TSA, 2002

Harvest forecast	Initial harvest (m^3/year)	Volume change from base case (m^3)	Per cent change from base case (%)	Change in decades for the decline	Long-term harvest (m^3/year)	Volume change from base case (m^3)	Per cent change from base case (%)
Coniferous	1 763 000	69 000	4.1	Nil	1 763 000	69 000	4.1
Small pine	110 000	Nil	Nil	Nil	108 000	9 000	9.1
Deciduous	915 000	Nil	Nil	Nil	681 000	49 000	7.8
Total	2 788 000	69 000	2.5		2 552 000	127 000	5.2

Table 13. The effect on the harvest forecast of decreasing managed stand yields by 10% — Fort St. John TSA, 2002

Harvest forecasts	Initial harvest (m^3/year)	Volume change from base case (m^3)	Per cent change from base case (%)	Change in decades for the decline	Long-term harvest (m^3/year)	Volume change from base case (m^3)	Per cent change from base case (%)
Coniferous	1 534 000	(160 000)	(9.5)	Nil	1 534 000	(160 000)	(9.5)
Small pine	110 000	Nil	Nil	Nil	88 000	(11 000)	(11.1)
Deciduous	915 000	Nil	Nil	Nil	560 000	(72 000)	(11.4)
Total	2 559 000	(160 000)	(5.9)		2 252 000	(243 000)	(10.0)

The 10% increase in managed stand yields is large enough to increase the entire even-flow harvest forecast of the coniferous component by 4.1%. Only the long-term harvest levels of the other components are affected. Reduction of managed stands yields results in reduced even-flow coniferous harvest forecast as well as a decreased long-term harvest levels for other components.

5.8 Uncertainty in the mixed-wood harvest levels

Stands that are not predominantly (> 80%) conifer or predominantly deciduous are considered mixed-wood in this analysis. Coniferous mixed-wood stands have at least a 20% aspen content whereas deciduous mixed-wood stands have at least a 20% conifer content. There are 195 650 hectares (18.5%) of coniferous mixed-wood stands in the timber harvesting land base and 144 100 hectares (13.6%) of deciduous mixed-wood stands in the timber harvesting land base.

The coniferous volume reported in the base case and all sensitivity analyses include the deciduous component of coniferous stands. Similarly, the deciduous volume includes the coniferous component of deciduous stands. The contribution of the secondary species in mixed-wood stands can be significant and sensitivity analysis was performed to examine the effect of not harvesting the secondary component of these stands. Table 14 and Table 15 show the effect on timber supply if the secondary component of mixed-wood stands is not harvested.

Table 14. Mixed-wood sensitivity analysis — remove deciduous species from the coniferous mixed-wood stands — Fort St. John TSA, 2002

Harvest forecast	Initial harvest (m^3/year)	Volume change from base case (m^3)	Per cent change from base case (%)	Change in decades for the decline	Long-term harvest (m^3/year)	Volume change from base case (m^3)	Per cent change from base case (%)
Coniferous	1 542 000	(152 000)	(9.0)	Nil	1 542 000	(152 000)	(9.0)
Small pine	110 000	Nil	Nil	Nil	99 000	Nil	Nil
Deciduous	915 000	Nil	Nil	Nil	618 000	(14 000)	(2.2)
Total	2 567 000	(152 000)	(5.6)		2 259 000	(166 000)	(6.9)

Table 15. Mixed-wood sensitivity analysis — remove coniferous species from the deciduous mixed-wood stands — Fort St. John TSA, 2002

Harvest forecast	Initial harvest (m^3/year)	Volume change from base case (m^3)	Per cent change from base case (%)	Change in decades for the decline	Long-term harvest (m^3/year)	Volume change from base case (m^3)	Per cent change from base case (%)
Coniferous	1 694 000	Nil	Nil	Nil	1 694 000	Nil	Nil
Small pine	110 000	Nil	Nil	Nil	99 000	Nil	Nil
Deciduous	915 000	Nil	Nil	(2)	478 000	(154 000)	(24.4)
Total	2 719 000	Nil	Nil		2 271 000	(154 000	(6.4)

The sensitivity analysis in Table 14 shows that short- and long-term coniferous harvest levels will be decreased by 9% if the deciduous species are not harvested from coniferous-dominated stands. The harvest of the deciduous species in coniferous stands is critical to maintaining base case harvest levels.

The sensitivity analysis in Table 15 shows that the initial deciduous harvest level can be maintained for one decade if the coniferous component in deciduous-dominated stands is not harvested. After one decade the harvest must decline a long-term harvest level that is 24% below that of the base case.

The current market for aspen in the Fort St. John TSA is small and harvesting has been minimal. In this circumstance the coniferous harvest level cannot be maintained without the harvest of the deciduous content of coniferous dominated stands. However, the market may change in the near future as there are expectations that a mill utilizing aspen will be built locally.

A review of both mixed-wood sensitivities indicates that the aspen contribution to the coniferous harvest (152 000 cubic metres per year) is about the same as the coniferous contribution (154 000 cubic metres per year) to the deciduous harvest. Therefore, the overall deciduous and coniferous content of the base case is reflected by the individual harvest flows.

5.9 Uncertainty in stand merchantability definition

The minimum merchantability requirements for stands to be harvested with conventional systems (cut and skid) are:

- subalpine fir and spruce — 140 cubic metres per hectare by age 120;
- pine — 140 cubic metres per hectare by age 80; and
- aspen — 120 cubic metres per hectare by age 100.

The minimum merchantability requirement for stands to be harvested with unconventional systems (cable or helicopter) is:

- 250 cubic metres per hectare by age 120 for spruce and subalpine fir, and 250 cubic metres per hectare by age 80 for pine.

Forest industry representatives have indicated that the above requirements may be high; especially during times when end-product prices are high. A sensitivity analysis was performed where the volume criterion for conventional harvesting was reduced to 100 cubic metres per hectare. The unconventional criterion was reduced to 200 cubic per hectare. Changing the merchantability requirements increased the size of the timber harvesting land base by 95 530 hectares. Inclusion of these stands decreased the average site index in the poor analysis units. As a result, volume tables and minimum harvestable ages for the affected analysis units were revised. Table 16 shows the impact on timber supply if the merchantability requirements are reduced.

Table 16. Reduction of minimum merchantability requirements — Fort St. John TSA, 2002

Harvest forecast	Initial harvest (m^3/year)	Volume change from base case (m^3)	Per cent change from base case (%)	Change in decades for the decline	Long-term harvest (m^3/year)	Volume change from base case (m^3)	Per cent change from base case (%)
Coniferous	1 761 000	67 000	4.0	Nil	1 761 000	67 000	4.0
Small pine	110 000	Nil	Nil	Nil	99 000	Nil	Nil
Deciduous	915 000	Nil	Nil	1	714 000	82 000	13.0
Total	2 786 000	67 000	Nil		2 574 000	149 000	6.1

Reducing the merchantability criteria increases the size of the timber harvesting land base, which increases the overall timber supply of the TSA. The coniferous harvest is increased by 67 000 cubic metres per year (4.0%). The deciduous harvest is increased in the mid-term with the maintenance of the initial harvest level for one more decade and the long-term harvest level is increased by 82 000 cubic metres per year (13%). The impact on the small pine forecast is negligible, as the small pine merchantability requirements are less than that of the base case coniferous land base.

5.10 Uncertainty in unsalvaged losses

Each year natural events such as wildfire, pests and windthrow kill trees within the Fort St. John TSA. District staff manage losses through salvage timber harvesting. However, not all trees are harvested for reasons such as accessibility and the economics of some operations. These are unsalvageable losses and are accounted for in the base case. District staff estimate the average yearly loss to be 37 500 cubic metres per year for coniferous species.

Historically there has been little deciduous harvesting in the TSA, which results in little data to estimate deciduous unsalvageable losses. If operations do commence at the base case harvest levels, district staff estimate losses may be as high as 10% of the harvest (91 500 cubic metres per year). However, there is no data to support using this estimate in the analysis.

Natural disturbance on the area not available for harvest has been factored in the analysis and is discussed in Section 5.3, "Uncertainty in the rate of natural disturbance on the non-timber harvesting land base."

5.11 Uncertainty in minimum harvestable ages

Minimum harvestable ages are an estimate of the time needed for stands to reach a merchantable condition. They affect the time over which the harvest of existing stands must be rationed while regenerating stands grow to a merchantable age. The time at which stands will become merchantable is not known with precision because of uncertainty about the growth of regenerated stands, and an inability to foresee future conditions that will determine merchantability.

For this analysis, coniferous stands harvested with conventional harvest systems are assumed to be merchantable at the age at which they attain a volume of 140 cubic metres per hectare. The criterion for deciduous stands is 120 cubic metres per hectare. Stands (coniferous only) harvested using unconventional harvest systems are assumed to be merchantable at the age at which they attain a volume of 250 cubic metres per hectare.

Sensitivity analysis was performed to assess the impact of increasing and decreasing minimum harvestable ages by 10 years. Table 17 and Table 18 show the results of the analysis.

5 Timber Supply Sensitivity Analyses

Table 17. Effect of increasing minimum harvestable ages by 10 years — Fort St. John TSA, 2002

Harvest forecast	Initial harvest (m^3/year)	Volume change from base case (m^3)	Per cent change from base case (%)	Change in decades for the decline	Long-term harvest (m^3/year)	Volume change from base case (m^3)	Per cent change from base case (%)
Coniferous	1 707 000	13 000	0.8	Nil	1 707 000	13 000	0.8
Small pine	110 000	Nil	Nil	Nil	99 000	Nil	Nil
Deciduous	915 000	Nil	Nil	(2)	648 000	16 000	2.5
Total	2 732 000	13 000	0.5		2 454 000	29 000	1.2

Table 18. Effect of decreasing minimum harvestable ages by 10 years — Fort St. John TSA, 2002

Harvest forecast	Initial harvest (m^3/year)	Volume change from base case (m^3)	Per cent change from base case (%)	Change in decades for the decline	Long-term harvest (m^3/year)	Volume change from base case (m^3)	Per cent change from base case (%)
Coniferous	1 666 500	(27 500)	(1.6)	Nil	1 666 500	(27 500)	(1.6)
Small pine	110 000	Nil	Nil	Nil	99 000	Nil	Nil
Deciduous	915 000	Nil	Nil	(1)	599 000	(33 000)	(5.2)
Total	2 691 500	(27 500)	(0.1)		2 364 500	29 000	(2.5)

The sensitivity analysis indicates that on average the minimum harvestable ages (MHA) are below culmination age (the age at which volume production is the greatest) and by increasing the MHA by 10 years, there is a small increase in timber supply. Conversely, decreasing the MHA by 10 years results in a small decrease in timber supply.

5.12 Uncertainty in green-up ages

The *Forest Practices Code (FPC)* requires that trees in a harvested area must reach a specified height (green-up height) before adjacent areas are harvested. To ensure that harvesting-related disturbance does not become overly concentrated in any area, a maximum limit was set on the overall area that has not reached green-up condition. In this analysis, the Milligan Hills caribou management area was not considered greened-up until the adjacent stands were 50 years old.

Green-up for the IRM zone was 3 metres and 5 metres for areas with visual quality objectives. The Ministry of Forests' August 2000 publication, *Age to green-up height: Using regeneration survey data by region, species and site index* was used to derive ages for coniferous species and the Ministry of Forests model 'Site Tools' was used to derive aspen ages.

Sensitivity analysis was performed to assess the impact of increasing and decreasing green-up ages by 5 and 10 years. An increase or decrease of 10 years equates approximately a 2-metre change in height. The results showed the changes to green-up ages had no impact on timber supply.

5.13 Uncertainty in adjacency restrictions and modelling approximations

In this analysis, it was assumed that a maximum of 40% of the timber harvesting land base of the integrated resource management (IRM) zone could be covered by stands that have not met the green-up condition. The IRM zone covered 84.7% of the timber harvesting land base.

A sensitivity analysis was performed to assess the impact on timber supply of a changing the maximum allowable area below green-up from 40% to 25%, effectively making the forest cover requirement more restrictive. Table 19 shows the results of the sensitivity analysis.

Table 19. Impact of increasing the adjacency requirement from 40% to 25% — Fort St. John TSA, 2002

Harvest forecast	Initial harvest (m^3/year)	Volume change from base case (m^3)	Per cent change from base case (%)	Change in decades for the decline	Long-term harvest (m^3/year)	Volume change from base case (m^3)	Per cent change from base case (%)
Coniferous	1 694 000	Nil	Nil	Nil	1 694 000	Nil	Nil
Small pine	110 000	Nil	Nil	Nil	99 000	Nil	Nil
Deciduous	915 000	Nil	Nil	Nil	620 000	(12 000)	(1.9)
Total	2 719 500	Nil	Nil		2 413 000	(12 000)	(0.5)

The sensitivity analysis results show a negligible long-term impact on timber supply if the area allowed to be below green-up age was reduced from 40% to 25%.

5.14 Uncertainty in forest cover requirements for visual quality objectives

Approximately 3.5% of the non-timber harvesting land base and 3.5% of the timber harvesting land base are managed for visual quality objectives. Figure 7 shows the amount of area in each VQO class. The majority of area is classed as modification* (48.6%) and partial retention* (40.4%). The remaining areas are classed as preservation, retention* and maximum modification. For each class the Ministry of Forests, Forest Practices Branch has provided a range of allowable visible disturbance. In the base case, the mid-point of the allowable visible disturbance range was assumed.

Uncertainty about visual quality objectives and forest cover objectives may arise from many sources including:

- inventory and classification of land into visual quality classes and sensitivity categories;
- estimates of how well different disturbance limits meet visual objectives;
- estimates of how non-harvestable forest may contribute to visual quality;
- variations in the timing of stand establishment; and
- uncertainties about growth and yield estimates (see Section 5.12, "Uncertainty in green-up ages").

The visual resource inventory was last updated in 1997 and is considered current by the Fort St. John Forest District staff. Within some landscape units, visual quality is not always managed at the mid-point of the allowable visible disturbance range. A sensitivity analysis was performed using the lower end of the disturbance range for all visual quality classes. The impact on timber supply is presented in Table 20.

Table 20. Impact of using the lower end of the visible disturbance range in areas managed for visual quality — Fort St. John TSA, 2002

Harvest forecast	Initial harvest (m^3/year)	Volume change from base case (m^3)	Per cent change from base case (%)	Change in decades for the decline	Long-term harvest (m^3/year)	Volume change from base case (m^3)	Per cent change from base case (%)
Conifer	1 692 500	(1 500)	(0.1)	Nil	1 692 500	(1 500)	(0.1)
Small pine	110 000	Nil	Nil	Nil	100 000	1 000	1.0
Deciduous	915 000	Nil	Nil	Nil	620 000	(12 000)	(1.9)
Total	2 717 500	(1 500)	Nil		2 412 500	(12 000)	(0.5)

The sensitivity analysis shows that more restrictive levels of allowable visible disturbance in areas managed for visual quality in the Fort St. John TSA had a negligible impact on the base case timber supply.

Modification VQO
*Visible alterations may dominate the landscape, but should blend with natural features. Up to 25% of the visible area can be altered by harvesting activity (see **Visual quality objective**).*

Partial retention VQO
Alterations may be visible but not conspicuous. Up to 15% of the area can be visibly altered by harvesting activity (see Visual quality objective).
Retention VQO
*Alterations are not easy to see. Up to 5% of the visible landscape can be altered by harvesting activity (see **Visual quality objective**).*

5.15 Uncertainty in application of seral stage* retention recommendations

The *Forest Practices Code of British Columbia Act* (*FPC*) describes the conservation of biodiversity as an essential component of sustainable forest use. The *Landscape Unit Planning Guide (LUPG)* provides recommendations for maintaining biodiversity at both the stand- and landscape-levels.

Stand-level biodiversity

Stand-level biodiversity is addressed in the Fort St. John TSA through the retention of wildlife tree patches. Based on information in the *Landscape Unit Planning Guide*, reductions for wildlife tree patch requirements are recommended for both coniferous and deciduous stands in each landscape unit (see Appendix A, Section A.4.4.2, "Wildlife tree patches (WTPs)"). Since the reductions were derived from field surveys (year 2000 data), it was not considered necessary to have any sensitivity analyses done.

Landscape-level biodiversity

Management for landscape-level biodiversity was modelled in this analysis through the use of forest cover requirements applied to each combination of natural disturbance type (NDT)*, biogeoclimatic subzone, and variant within each landscape unit. In the base case, old-growth targets, as indicated in the *Landscape Unit Planning Guide*, were applied at the biogeoclimatic variant level within each draft landscape unit. The targets used are based on the draft biodiversity emphasis option (BEO) assigned to each of the draft landscape units (see Appendix A, Section A.4.4.1, "Forest cover requirements").

While the approach to modelling old-seral stage requirements in the base case represents the best available information; the BEOs and landscape units are still considered draft. A sensitivity analysis was performed to assess the impact of using the 45/45/10 procedure for assigning old-seral targets. The procedure sets the targets as a weighted average of the low-, medium- and high-BEO targets with 45% of the area assumed to be low emphasis, 45% assumed to be medium and 10% assumed to be high. In low BEO areas an initial reduction (phase-in) of the old-seral forest requirements to one-third of the target is allowed. Table 21 shows the impact on the base case when the 45/45/10 procedure is used.

Seral stages
Sequential stages in the development of plant communities that successively occupy a site and replace each other over time.

Natural disturbance type (NDT)
An area that is characterized by a natural disturbance regime, such as wildfires, which affects the natural distribution of seral stages. For example areas subject to less frequent stand-initiating disturbances usually have more older forests.

Table 21. Impact of using the 45/45/10 procedure to set old-seral targets for landscape level biodiversity — Fort St. John TSA, 2002

Harvest forecast	Initial harvest (m^3/year)	Volume change from base case (m^3)	Per cent change from base case (%)	Change in decades for the decline	Long-term harvest (m^3/year)	Volume change from base case (m^3)	Per cent change from base case (%)
Coniferous	1 695 000	1 000	0.1	Nil	1 695 000	1 000	0.1
Small pine	110 000	Nil	Nil	Nil	97 500	(1 500)	(1.5)
Deciduous	915 000	Nil	Nil	Nil	620 000	(14 000)	(2.2)
Total	2 720 000	1 000	0.1		2 410 500	(14 500)	(0.5)

The impact of using the alternative procedure for setting landscape unit old-seral targets has a negligible impact on timber supply.

A review of model outputs indicates that mature-seral* stage requirements are being met without applying forest cover requirements. Therefore, a sensitivity analysis applying these requirements was not performed.

5.16 Uncertainty in site productivity estimates

The productivity of a site largely determines how quickly trees will grow and is measured by site index. In the analysis, site index affects how fast stands reach green-up age, the age at which stands become merchantable and the volumes at harvest.

The most accurate estimates of site productivity comes from stands between 30 and 150 years old. At ages less than about 30 years, (particularly stands less than 15 years) the growth history of trees is too short to give accurate measurements of site productivity using conventional site index tools (site curves) and inventory estimates of height and age.

Site productivity estimates derived for older stands may also be incorrect as stands are well past the age of maximum height growth and have often been affected by disease, insects and top damage as they reach an advanced age. As a result, measurements from these trees can lead to underestimation of the growing potential of the site. If the site productivity estimates from these older stands are used to estimate the growth potential of young replacement stands, volume growth could also be underestimated.

An alternative approach to estimating post-harvest site index of the mature and old forest is to use the *Site Index — Biogeoclimatic Ecosystem Classification (SIBEC)* study (Forest Renewal B.C. and Ministry of Forests, B.C., 1997). Results present a first approximation of estimates of average site index for coniferous crop tree species according to site units of the biogeoclimatic ecosystem classification (BEC) system of B.C. The estimates are presented in site index — site unit tables and the correlation between site index and site units varies from weak to moderately strong across species and sites.

To test the sensitivity of the base case harvest forecast to the uncertainty in site productivity estimates the results of the SIBEC study were applied to the coniferous analysis units in the timber harvesting land base. Since the area-weighted average site index obtained from the SIBEC study was only 0.31 metres greater than the area-weighted average site index used in the base case, no sensitivity analysis was performed.

Mature seral
Forest stands with trees between 80 and 120 years old, depending on species, site conditions and biogeoclimatic zone.

6 Summary and Conclusions of the Timber Supply Analysis

Timber supply was assessed for small pine, coniferous- and deciduous-leading stands in the Fort St. John TSA.

Small pine stands are defined as lodgepole pine stands greater than 80 years of age and, between 17.7 and 19.4 metres in height. This analysis suggests that it is possible to harvest 110 000 cubic metres per year of small pine for the first 160 years and after which the harvest must decrease to the long-term harvest level of 99 000 cubic metres per year.

Coniferous stands include subalpine fir-, lodgepole pine- and white spruce-dominant stands that are, or have the potential to grow to at least 19.4 metres in height by age 80 years. Results suggest that the coniferous-dominant timber supply can be maintained at 1 694 000 metres per year over the entire forecast horizon.

Finally, deciduous stands include aspen-leading stands. Results suggest that the current deciduous AAC of 915 000 cubic metres per year can be maintained for 30 years, after which it must decrease by 10% per decade to the long-term harvest level of 632 000 cubic metres per year.

The timber supply analysis examined the impact of increasing the initial harvest levels by increments of 10%. Results from the coniferous land base show that initial increases are not possible without disruptions in long-term timber supply. Conversely, the analysis shows that an initial increase of 10% is possible for the deciduous timber supply and a 20% increase is possible for the small pine timber supply with small disruptions to long-term timber supply.

Currently there is a small market for aspen species within the Fort St. John TSA. Sensitivity analysis indicates that if aspen is not harvested in the mixed-wood coniferous stands (18.5% of the timber harvesting land base) the coniferous harvest level will drop by 9%, or 152 000 cubic metres per year. If the coniferous species is not harvested in mixed-wood deciduous stands (13.6% of the timber harvesting land base) the initial deciduous harvest level can only be maintained for 10 years and the long-term harvest drops 24.4%, or 154 000 cubic metres per year, to 478 000 cubic metres per year.

The largest source of uncertainty in the analysis is the estimation of aspen and mixed-wood stand volumes. Data suggest that the volume in stands between 50 and 100 years old is underestimated. Ministry of Forests district staff believe aspen volumes are underestimated for all ages. A sensitivity analysis was performed where aspen volumes were increased by 20 and 40%. Results show that the initial aspen harvest level could be maintained for at least 100 years and the long-term harvest level would be increased.

A second factor associated with the deciduous harvest is the economic feasibility of harvesting in the north-east portions of the TSA (timber supply Block F). Sensitivity analysis shows that if there is no deciduous harvest in this portion of the TSA, the initial deciduous harvest can only be maintained for one decade and the long-term harvest level must decrease by 22% or 140 000 cubic metres per year.

Industry representatives suggest that more stands could be considered merchantable than modelled in the base case. Sensitivity analysis was performed reducing the minimum volume limits to 100 cubic metres per hectare for the conventional land base and 200 cubic metres per hectare for the cable/helicopter land base. Results show the coniferous harvest would increase by 67 000 cubic metres per year (4.0%) and the deciduous long-term harvest level would increase by 82 000 cubic metres per year (13%).

Sensitivity analysis shows that the oldest-first harvest rule is less constraining on timber supply than the random harvest rule (with priorities) used in the base case. Fort St. John Forest District staff feel the random rule as applied in the base case is more representative of the actual harvest. Review of the stands allocated in development plan supports the use of the modified random rule.

The remaining sensitivity analyses exploring uncertainty in data or current performance show that the overall timber supply is not affected by more than 10%.

The coniferous harvest level is modelled as even-flow so any uncertainty that affects the coniferous timber supply changes it for the entire planning horizon. For the deciduous and small pine timber supplies, in general the initial harvest levels can be maintained, with most impacts occurring in the mid- to long-term.

7 Socio-Economic Analysis

The impact of timber supply adjustments on local communities and the provincial economy is an important consideration in the timber supply review. The socio-economic analysis compares the level of forestry activity currently supported by timber harvested from the Fort St. John TSA to the level of activity that the TSA could support as the timber supply approaches its long-term harvest level.

The socio-economic analysis examines harvest levels as projected in the base case harvest forecast and is not intended to examine alternative management scenarios.

The socio-economic analysis consists of the following:

1. a profile of the current socio-economic setting;
2. a description of the Fort St. John TSA forest industry; and
3. an analysis of the socio-economic implications of the base case harvest forecast.

7.1 Current socio-economic setting

7.1.1 Current population and demographic trends

In 2001, the population of the Fort St. John Forest District was approximately 28,250 people.[1] The largest community in the Fort St. John Forest District is Fort St. John with a population of 16,034 people in 2001.[2] Other smaller communities located in the forest district include Taylor with a population of 1,143, Halfway River, Blueberry River, and Doig River.

Most of the population growth occurred in the City of Fort St. John. Although the population increased in Taylor and more rural areas of Census Subdivision C also. The population of the forest district is expected to increase by approximately 6.3% between 2001 and 2005. Table 22 shows the population levels for the Fort St. John Forest District, more rural areas of the regional district and communities where data are available.

Table 22. Fort St. John Forest District population statistics, 1991-2005

	1991	1996	2001[a]	2005[a]	Per cent (%) change 1996-2001
Fort St. John	14,589	15,021	16,034	N/A	6.7
Taylor	844	1,031	1,143	N/A	10.9
Peace River Regional District Census Subdivision B		5,041	4,997	N/A	–0.9
Peace River Regional District Census Subdivision C[b]	8,820	5,251	5,830	N/A	11.0
Fort St. John Forest District	23,991	26,627	28,250	31,350	6.1
British Columbia	3,282,910	3,882,043	4,096,894	4,321,939	5.5

(a) Forest District population estimates for 2005 based on 1996-2005 population growth rates for the Peace River North Local Health Area and the Peace River Regional District.

(b) 1991 population data for Census subdivison C includes population for subdivision B.

Source: Census of Canada 1991, 1996, 2001. B.C. Stats Population Section.

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(1) B.C. Stats, Population Section, B.C. Ministry of Finance and Corporate Relations. Forest District population estimates for 2001 and 2005 based on 1996-2001 population growth rates for the Peace River North Local Health Area and the Peace River Regional District.

(2) Census of Canada, 2001.

7.1.2 Economic profile

The Fort St. John TSA is one of the most diversified regions of the province.[3] The oil and gas sector continues to be the leading employer in the timber supply area supporting approximately 26% of the labour force (see Figure 23). The public sector is the second largest employer supporting approximately 22% of the direct and indirect labour force. This is followed by travel and tourism-related employment supporting approximately 14% of the labour force at accommodation and other service businesses, which cater to both business and tourism travel. Forestry accounts for 9% of the labour force, as does agriculture and construction. In 2001, the Northeast Development Region, which also includes the Fort Nelson and Dawson Creek Forest Districts, had the lowest unemployment rate of all development regions in the province: 5.6% *versus* the provincial average of 7.7%.

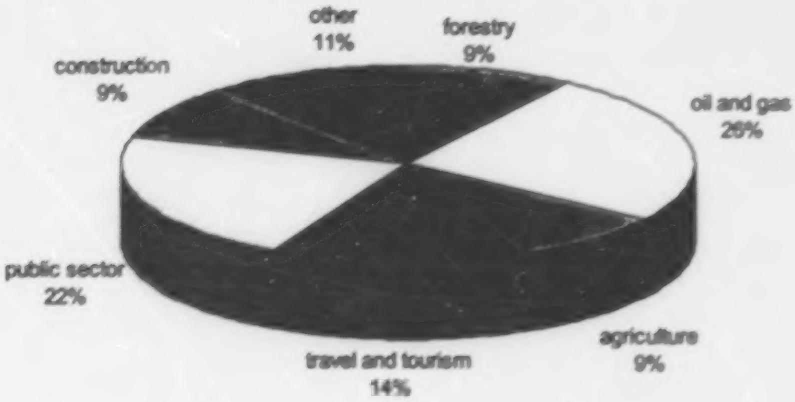

Figure 23. Fort St. John TSA experienced labour force by sector, 1996.

Source: B.C. Ministry of Finance and Corporate Relations. 1999. The 1996 Forest District Tables.

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(3) Ministry of Finance. 1999. *British Columbia Local Area Economic Dependencies and Impact Ratios — 1996*. Victoria, B.C. Ministry of Finance and Corporate Relations.

Figure 23 is based on data from the 1996 Census, subsequently it may not reflect the local economy as accurately as if more timely data were available. Census 2001 labour force data will not be available until 2003.

The northeast region of British Columbia, as well as the province as a whole, has benefited from the oil and gas expansion of the 1990s. Increases in drilling activity and production levels accompanied record industry expenditures and revenues to government. Information from the Ministry of Energy and Mines states that:

- Industry expenditures reached $2.7 billion in 2000 — up 17% from the year before;
- The sales value of oil and gas production hit a record $4.6 billion — up 220% from 1999;
- British Columbia produces over one trillion cubic feet of natural gas per year;
- British Columbia produces about 16 million barrels of oil per year;
- Revenues to government totalled 1.294 million in 2000 — up 120% from 1999 and 250% since 1996;[4]
- The number of oil and gas wells drilled increased by 21% — from 620 wells in 1999 to 753 in 2000;
- Marketable natural gas production reached approximately 9.4 trillion cubic feet — an increase of approximately 100% since 1990.

The latest employment figures available for the Northeast Development Region (the Fort St. John Forest District accounts for about 43% the Development Region's total labour force) indicate that the goods producing sectors of forestry, fishing, mining, oil, and gas supported 4,600 people in 2000. This is up about 9.5% from 1999, but still remains roughly 20% below mid-1990s levels. Other sectors such as manufacturing have declined by as much as 30% since the mid-1990s. Service producing sectors, such as transportation, financial services, education, health and accommodation have surpassed employment levels of the mid-1990s and now employ over 21,000 people. The incomes and expenditures of the goods producing sectors support many of these service sector jobs.

The indirect and induced employment included in Figure 23 reflects the income spent by companies and employees and the number of jobs that depend on those expenditures. Employment multipliers illustrate this spending effect: a larger multiplier indicates that each job of a particular sector will support more business activity at supply and service companies, due to higher company revenues, supply requirements and wages. For example, estimates by the Ministry of Finance indicate that every 100 full-time direct forestry jobs in the Fort St. John TSA support an additional 51 to 88 indirect and induced full-time jobs, depending on the forestry activity (harvesting or processing). In comparison, every 100 full-time direct jobs in the oil and gas industry supports about 67 additional jobs, the tourism and business travel sectors support an estimated 19 indirect and induced jobs*, and every 100 jobs in the public sector support an additional 26 indirect and induced jobs. The differences are due to larger spending patterns by forestry sector businesses and their employees, which tend to have higher revenues, incomes, and spending patterns. The multipliers indicate how a change to a particular sector could affect the broader economy. Table 23 compares employment multipliers for sectors of the Fort St. John TSA economy.

Indirect and induced jobs
Indirect jobs are supported by direct business purchases of goods and services. Induced jobs are supported by employee purchases of goods and services; for example, at retail outlets.

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(4) Ministry of Energy and Mines. Fueling the Future: Overview of British Columbia Oil and Gas Activity. Fact Sheet. www.gov.bc.ca/em

Table 23. Employment multipliers, by sector, Fort St. John Forest District, 1996

Basic sector*	Employment multiplier
Forestry: logging and manufacturing	1.51 – 1.88
Agriculture and food	1.27
Travel and tourism	1.19
Public sector	1.26
Mining, oil and gas	1.67
High Tech	1.35

7.2 Fort St. John TSA forest industry

7.2.1 Current allowable annual cut

The current (effective December 1996) allowable annual cut (AAC) for the Fort St. John TSA is 2 015 000 cubic metres, divided into 1 100 000 cubic metres of coniferous volume and 915 000 cubic metres of deciduous volume. Table 24 provides a breakdown of the AAC by tenure type. Before 1996, the AAC was set at 1.8 million cubic metres.

Table 24. Fort St. John TSA allowable annual cut, by licence type

	AAC coniferous (cubic metres)	AAC deciduous (cubic metres)	AAC total (cubic metres)	Per cent (%) of total AAC
Forest Licences — replaceable	704 793		704 793	35.0
Forest Licences, non-replaceable	219 085	193 000	412 085	20.5
Pulpwood agreements		518 000	518 000	25.7
Small Business Forest Enterprise Program (SBFEP)	147 218	180 000	327 218	16.2
Forest Service Reserve	11 000	9 000	20 000	1.0
Woodlot licences* (unallocated)	17 904	15 000	32 904	1.6
Total	1 100 000	915 000	2 015 000	100.0

Source: Ministry of Forests.

Basic sector
Sectors of the economy, such as forestry, tourism and mining, that create flows of income into the region and are assumed to be drivers of the local economy. Non-basic sectors, such as retail outlets, are supported by basic sectors.

Woodlot licence
An agreement entered into under the Forest Act*. It allows for small-scale forestry to be practised in a described area (Crown and private) on a sustained yield basis.*

7.2.2 Fort St. John TSA harvest history

Table 25 summarizes the volume of timber harvested in the Fort St. John TSA from 1994 to 2001. The volume of timber harvested in any year is an important indicator of forestry activity in the TSA. While the AAC is the maximum allowable annual harvest level, the actual volume of timber harvested in a particular year determines the level of economic activity. Differences in annual harvest levels are the result of provisions for cut control[5] variations that allow licensees to vary their harvests based on operating and market conditions. If actual annual harvest levels consistently fall below the AAC, then the forestry industry is below its full potential.[6]

In 2001, approximately 1.1 million cubic metres were harvested from the Fort St. John TSA, of which 86% was coniferous (see Table 25). From 1999 to 2001, the deciduous harvest averaged about 139 000 cubic metres. This difference between the deciduous AAC and the harvest is due to the lack of harvesting under the Louisiana Pacific and Slocan deciduous apportionments, which are intended to supply the proposed oriented strandboard plant (see below).

Table 25. Fort St. John TSA volumes billed, by licence type, 1993 to 2000

	Cubic metres (m^3)							
Tenure	1994	1995	1996	1997	1998	1999	2000	2001
Forest licences (FL)	657 331	474 361	695 646	844 471	676 853	672 787	564 865	743 796
Small Business Forest Enterprise Program (SBFEP)	151 440	109 023	220 828	147 137	236 809	205 421	217 857	301 525
Other[a]	105 579	179 394	164 784	127 120	149 088	148 563	96 649	42 914
Total	914 350	762 778	1 081 257	1 118 727	1 062 749	1 026 771	879 372	1 088 234
AAC	1 803 066	1 803 066	2 015 000	2 015 000	2 015 000	2 015 000	2 015 000	2 015 000
Average harvest 1994-2001:				991 780				
Average harvest — current cut control 1998-2001:				998 126				

(a) "Other" consists of cutting permits such as rights-of-way, road permits, and other small temporary permits.

Source: Ministry of Forests, Economics and Trade Branch.

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(5) Cut control allows licensees to vary the volume between annual harvest and AAC by +/– 50 % per year, and by +/– 10 % over a 5-year cut control period.

(6) Full potential referred to here is based on the allocated volumes of the AAC, and is not necessarily the same as full economic potential which is based on the international market for wood products.

7.2.3 Fort St. John TSA major licensees and processing facilities

Canadian Forest Products Ltd. (Canfor)

Canadian Forest Products Ltd. (Canfor) has a replaceable forest licence in the Fort St. John TSA to harvest 704 793 cubic metres of timber per year. In 2001, Canfor harvested 767 404 cubic metres. Table 26 outlines Canfor recent harvest activity and 1998-2000 average employment levels associated with its Fort St. John TSA operations.

Table 26. Canfor volumes billed and provincial employment statistics

Allowable annual cut (AAC)	704 793 cubic metres	
2001 harvest[a]	743 796 cubic metres	
1998 – 2000 average annual volumes billed	673 199 cubic metres	
Employment[b] (1998 – 2000 person-years)		
Harvesting, administration and silviculture		177
Processing		237
Total		414

(a) Harvest levels include forest licence and cutting permit volumes.

(b) The employment figures relate to the 1998 – 2000 average volume of 673 199 m^3 harvested from the Fort St. John TSA only and processed in B.C.

In British Columbia, Canfor operates 11 lumber mills, a veneer and plywood mill, four pulp mills, two paper mills and two chip mills. Two of Canfor's lumber mills are located in the Fort St. John TSA, at Fort St. John and Taylor. From 1998 to 2000, Canfor's solid wood mills consumed about 8.3 million cubic metres of timber per year. The majority of the timber processed at Canfor's Fort St. John mills comes from the Fort St. John TSA. Residual chips are processed at the Slocan Taylor Division pulpmill.

Other licensees and processing facilities

Louisiana Pacific Canada Ltd. and Slocan Forest Products Ltd. each have tenures in the TSA. Louisiana Pacific has three non-replaceable forest licences in the Fort St. John TSA. One is to harvest 83 494 cubic metres of coniferous timber, of which 14 409 cubic metres is from a previous undercut volume. The other two are deciduous licences, one for 193 000 cubic metres and another short-term forest licence of 119 300 cubic metres, which is from previous undercut volume. No harvesting has taken place under these licenses at this time. Louisiana Pacific also has a small extension of a pulpwood agreement* amounting to another 18 000 cubic metres of deciduous.

Slocan has a pulpwood agreement to harvest 500 000 cubic metres of deciduous-leading stands in the TSA. No harvesting has taken place under this agreement at this time. Slocan Forest Products Ltd. and Louisiana Pacific Canada Ltd. have entered into a joint venture arrangement, Slocan-LP OSB Corp. with the intent that each company supply an equal amount of deciduous timber from their respective tenures to the proposed oriented strandboard (OSB) plant to be built in the TSA. It is anticipated that construction of the OSB plant will begin in either late 2002 or early 2003. Upon completion of construction of the OSB plant it is expected that each company will begin to fully harvest their respective licenses and agreements.

Pulpwood agreements
An agreement applying to a fixed geographic area that allows harvesting of timber below sawlog standards if mill residues suitable for the facility under the agreement are not available.

The remainder of the Fort St. John TSA timber supply is harvested under the Small Business Forest Enterprise Program which has a total AAC of 327 218 cubic metres. From 1999 to 2001, the average volume harvested under the SBFEP was 241 601 cubic metres per year. Recently a 70 000 cubic metres value-added small business non-replaceable forest licence was awarded to Cameron River Logging located in Taylor, B.C. This company will sort and grade lumber supplied from both Canfor mills and in addition will prepare finger-joint blanks to be shipped to other manufacturers.

Other than the two Canfor lumber mills in Fort St. John and Taylor, there is also one chip mill and Slocan's Taylor Division pulp mill. The Slocan pulp mill has the capacity to produce 240 000 metric tonnes of pulp per year. Its 2000 production level was 171 185 metric tonnes.[7] The softwood/hardwood chips necessary to run this pulp mill come from a variety of sources; however, the vast majority comes from chip trade arrangements with other major licensees.

North Peace Timber Ltd. runs a chipping facility located near the Canfor sawmill in Taylor. This company produces solely hardwood chips for export to Japanese markets. Its 2000 production level was 110 000 bone-dry units of chips. The deciduous timber to produce these chips originates primarily from private land and the purchase of timber from small business contractors.

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(7) Slocan Forest Products Ltd. 2000 Annual Report.

7.2.4 Forestry sector employment and employment coefficients

The preceding harvesting and employment information is used to develop employment coefficients to project future employment levels in the forestry sector. For this purpose, the forestry sector has been divided into three sub-sectors:

- harvesting and other woodlands-related employment including falling, log salvage, log scaling, log transport, harvest planning and administration;
- silviculture employment such as planting, surveying and other basic and intensive silviculture activities, such as spacing, fertilization and pruning*; and
- primary timber processing employment at lumber mills, veneer and plywood mills, shake and shingle mills, chip mills, log home mills and pulp and paper mills.

Harvesting and silviculture employment

The harvesting sub-sector of the forest industry includes both company and contract loggers and is the first sub-sector that would be affected by a change in the AAC. The predominant silvicultural system used in the Fort St. John TSA is clearcut with reserves. Logging systems used include ground-based skidding, with some cable-based systems (grapple yarding), helicopters and horse logging. The active logging season generally runs all year, but varies by company and weather conditions. Local residents account for an average of about 70-90% of the harvesting workforce.

Current activity in the silviculture sub-sector is less related to recent harvesting, given that silviculture activities are ongoing for as much as 10-15 years following harvesting. However, planting activity generally follows within 2-3 years unless natural regeneration is relied on to reforest the area. Basic silviculture consists of pre- and post-harvest surveys, site preparation, planting, brushing, cone collecting and some spacing. Enhanced, or intensive silviculture includes spacing, fertilization, and pruning. In the TSA, major licensees are responsible for basic silviculture on areas harvested under major licences. The provincial government is responsible for the remaining basic and all enhanced silviculture on Crown land, which is completed by silviculture contractors.

Employment data compiled for this timber supply review indicate that from 1998 to 2000, the average TSA harvest of 989 630 cubic metres per year supported about 288 person-years annually of direct harvesting and silviculture employment across the province. About 80% of this workforce reside in the Fort St. John TSA.

Processing employment

The majority of timber processed at local mills comes from the Fort St. John TSA, but some timber and chips come from adjacent forest districts. The Fort St. John TSA accounts for an average of approximately 85-90% of the timber requirement for local TSA mills.

Employment data compiled for this timber supply review indicate that from 1998 to 2000, the TSA harvest of 989 630 cubic metres per year supported approximately 375 person-years of direct processing employment across the province. About 91% of this processing employment is associated with operations in the Fort St. John TSA.

Forest Service employment

The Fort St. John Forest District office located in Fort St. John administers the Fort St. John TSA. Currently, 42 people work in the forest district office. Forest Service staff are involved in administration, enforcement of government policy, and SBFEP-related planning for the Fort St. John TSA. Current public sector downsizing has resulted in the district office being scheduled for closing in 2003.

Pruning
The manual removal of the lower branches of crop trees to a predetermined height to produce clear, knot-free wood.

Fort St. John TSA employment coefficients

Table 27 summarizes the employment supported by the 1998-2000 average harvest in the Fort St. John TSA and the corresponding employment coefficients. These coefficients have been calculated for the TSA and province to highlight the level of forestry activity within the Fort St. John TSA and to identify the contribution that the Fort St. John TSA's forestry sector makes to the provincial economy. The two employment levels are defined as follows:

- TSA employment and employment coefficients, which reflect residents of the Fort St. John TSA who are employed in the forestry sector within the Fort St. John TSA and who rely on the Fort St. John TSA timber supply; and
- Provincial employment and employment coefficients, which reflect all forestry sector employment in the province that relies on the Fort St. John TSA timber supply, including both residents of the Fort St. John TSA and those who live elsewhere.

Employment is divided into direct, indirect and induced components; the sum of the components is the total impact. The coefficients are expressed as the number of full-time jobs, or person-years, per 1000 cubic metres of timber harvested. Indirect and induced employment figures were derived using employment multipliers developed by the Ministry of Finance.

More detailed information regarding employment coefficients and multipliers is presented in Appendix B, "Socio-Economic Analysis Background Information."

Table 27. Fort St. John TSA employment and employment coefficients,[8] average 1998-2000

Forest industry activity	TSA employment (person-years)	TSA coefficients (person-years/ '000s m^3)	Provincial employment (person-years)	Provincial coefficients (person-years/ '000s m^3)
Harvesting	218	0.22	238	0.24
Silviculture	10	0.01	50	0.05
Processing	337	0.34	375	0.38
Total direct	565	0.57	663	0.67
Indirect + induced	315	0.32	762	0.77
Total employment	880	0.89	1,425	1.44

Note: Employment estimates are reported in person-years based on average 1998-2000 employment levels and the average 1998–2000 Fort St. John TSA harvest of 989 630 cubic metres per year.

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(8) Other employment coefficients may be found in other documents for the same or similar areas. A difference in ratios can occur for several reasons, such as using different sources of employment data and rounding of estimates, dividing employment by a different harvest level, using a different definition of a full-time position and changing the definition of forestry sub-sectors. However, the size of impacts associated with a timber supply change should illustrate similar effects.

7.2.5 Fort St. John TSA employment income

From 1998 to 2000, the average provincial income for forestry sector employees associated with the Fort St. John TSA harvest was $47,400, based on average provincial income levels for logging and forestry services, solid wood manufacturing and pulp and paper manufacturing (see Appendix B). Average income for indirect and induced sector employees was $30,800. The total direct income associated with the forestry sector in the Fort St. John TSA averaged $31.4 million per year and total income for indirect and induced employment averaged $23.5 million per year (incomes are reported in 1999 dollar values). Combined, total employment income in the Fort St. John TSA averaged $54.9 million per year. Table 28 shows income levels, average wages and salaries, and total income per 1000 cubic metres of harvested timber.

Table 28. Provincial average direct and indirect and induced incomes and total employment income, 1998-2000

	Average wage (1999 dollar value)	Total income ($ millions)	Total income ($/'000s m^3)
Direct	47,400	31.4	31,755
Indirect + induced	30,800	23.5	23,715
Total income		54.9	55,470

Source: Statistics Canada. Annual estimates of employment, earnings and hours. Catalogue # 10—3009XKB.

Statistics Canada. Labour Force Survey, Average weekly wage rate.

7.2.6 Provincial government revenues

The provincial government receives various taxes and other revenues from the forest industry. The forest industry pays stumpage, royalties and rents to the provincial government for the rights to timber and its use, and other industry operating taxes such as corporate income, property, and sales taxes. The provincial and federal governments also receive revenues from forestry employees directly through income taxes.

From 1998 to 2000, forest industry activity in the Fort St. John TSA provided an average of about $23.1 million in annual stumpage payments to the provincial government. Other government revenues from forest industry taxes accounted for $9.0 million per year. Total employment supported by the Fort St. John TSA harvest generated total annual provincial and federal income taxes worth $14.7 million. About one-third of the total income tax, or $4.9 million per year goes to the provincial government. Table 29 shows average annual provincial government revenues for 1998-2000.

Table 29. Average annual provincial government revenues, 1998-2000

	Average annual revenue 1998-2000 (1999 dollar value)	Average revenue ($/'000s m^3)
Stumpage	23.1	23,340
Industry taxes	9.0	9,050
Provincial income tax	4.9	4,909
Total provincial government revenues	37.0	37,299

Sources: Ministry of Forests, Revenue Branch; PricewaterhouseCoopers; Canada Customs and Revenue Agency (CCRA).

7.3 Socio-economic implications of the base case harvest forecast

The socio-economic analysis focuses on harvest level changes 10 to 30 years from now and considers:

- the implications of alternative harvest levels for both the Fort St. John TSA and the province;
- possible impacts on communities within the TSA;
- timber requirements of processing facilities within the Fort St. John TSA; and
- regional timber supply implications.

The socio-economic analysis considers average levels of forest industry related activity that the base case harvest forecast could support. Impacts associated with future harvest levels are calculated using employment, income and revenue coefficients (per 1000 cubic metres). This method assumes that the current role of the forest industry in the provincial economy and labour productivity will not change. For example, employment levels in the future can be predicted based on the current relationship between employment and the volume of timber harvested and processed. The analysis also assumes that the proportions of harvesting, silviculture and timber processing employment will remain constant and that the types and proportions of wood products manufactured will remain the same.

While this method is reasonably accurate for short-term forecasts (within the next five years), employment coefficients 20 years from now may differ due to changes in market conditions, timber processing technologies, for example. The analysis indicates the magnitude of impacts to employment, employment income and provincial government revenues, within a constantly changing socio-economic environment.

7.3.1 Short- and long-term implications of alternative harvest levels

Employment and income impacts in the Fort St. John TSA

Fort St. John TSA employment and income impacts focus on those workers who are supported by the TSA harvest and who reside within the TSA. Workers who come to the TSA to work but who reside outside the TSA are included in the provincial impact section, as are those supported by Fort St. John TSA timber processed at mills located outside the forest district. Table 30 indicates the employment and income that the current AAC and base case forecast could support if the timber is fully harvested and processed.

The current AAC of 2 015 000 cubic metres, if fully harvested, can support about 1,149 person-years of direct employment and a further 645 person-years of indirect and induced employment within the TSA. This level of employment would result in about $76.4 million in annual total employment income.

However, from 1999 to 2001 the average harvest level was 998 126 cubic metres per year.[9] As such, the Fort St. John TSA AAC is not at its full employment potential, in terms of the current available timber supply. Dates have not been announced for the construction and start-up of the joint Slocan-LP OSB plant, which will use some of the deciduous supply. When this plant is in operation additional direct forestry employment in logging, forestry services and processing could amount to about 350 person-years.

The projected timber supply of 2 713 400 cubic metres per year indicated in the base case forecast could increase employment supported by the forest sector to 1,547 person-years of direct employment and a further 868 person-years of indirect and induced employment. This assessment assumes that a similar ratio of TSA to non-TSA employment will continue, which assumes that additional milling capacity would be constructed within the TSA.

Given the long-term stability of the timber supply as indicated by the timber supply forecast, it is assumed that employment associated with the Fort St. John TSA will either remain near its current level, or will increase to meet market opportunities, such as with the proposed OSB plant.

Provincial employment and income impacts

Provincial employment and income impacts include all the activity supported by the Fort St. John TSA harvest, regardless of processing location and place of residence.

From 1999 to 2001, the average harvest was about one million cubic metres per year and supported about 669 direct and 769 indirect and induced person-years of employment across the province.

The current AAC of 2 015 000 cubic metres could support about 1,350 person-years of direct employment and a further 1,552 person-years of indirect and induced employment across the province. This level of employment results in $116.9 million in annual total provincial employment income.

The projected timber supply of 2 713 400 cubic metres per year could support about 1,818 person-years of direct employment. Attaining this level of harvest and processing would be more dependent on market demand, than on the available timber supply.

As with the TSA assessment, given the long-term stability of the timber supply, it is assumed that employment levels will remain the same, or increase within the range presented in Table 30.

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(9) Section 7.2 refers to employment, income and government revenues and related coefficients based on survey data and harvest levels from 1990-2000 In Section 7.3, the coefficients are used to update the estimates of employment, income and government revenues based on the average 1999-2001 harvest in order to provide a more current assesement of potential socio-economic impacts.

Table 30. Fort St. John TSA socio-economic impacts: base case harvest forecast

	Current harvest rate	Current AAC	Projected timber supply
Timber supply ('000s m³/year)	2 015 000	2 015 000	2 713 400
Harvest level (1999-2001 average)	998 126		
Difference from current AAC	1 016 874		
Fort St. John TSA			
Employment		(person-years)	
Direct	569	1,149	1,547
Indirect + induced	319	645	868
Total	888	1,793	2,415
Range of employment gain (loss) from current harvest level		815—905	1,375—1,527
Employment income		($1999 million per year[a])	
Direct	27.0	54.5	73.3
Indirect + induced	10.9	22.0	29.6
Total	37.9	76.4	102.9
Province[b]			
Employment		(person-years)	
Direct	669	1,350	1,818
Indirect + induced	769	1,552	2,089
Total	1,437	2,902	3,907
Range of employment gain (loss) from current harvest level		1,275-1,465	2,150—2,470
Employment income		($1999 million per year)	
Direct	31.7	64.0	86.2
Indirect + induced	26.2	52.9	71.2
Total	57.9	116.9	157.4
Provincial government revenues		($1999 million per year)	
Stumpage and related payments	23.3	47.0	63.3
Forest industry taxes	9.0	18.2	24.6
Employee income taxes	4.9	9.9	13.3
Total	37.2	75.1	101.2

(a) $1999 indicates that dollar amounts reflect the value of a dollar in 1999 accounting for any year to year effects of inflation.

(b) TSA employment and income estimates are included in the provincial employment and income estimates.

Provincial government revenue impacts

Provincial government revenues from the forest industry include stumpage, royalties and rent payments; other taxes such as logging, corporate income, sales, property and electricity taxes; and income taxes from direct, indirect and induced employees. Under the existing tax and stumpage regimes, the current average harvest rate provides approximately $37.2 million in government revenues. A timber supply of 2 015 000 cubic metres, if fully harvested, would provide on average about $75.1 million annually to the provincial government, while increasing the harvest to the projected timber supply level could increase government revenues to $101.2 million per year.

7.3.2 Community-level impacts

The impacts related to changes in the timber supply can affect the socio-economic environment of a community. A reduction in employment and income can affect various socio-economic conditions in communities: for example, population growth rates, the size of the labour force, economic development opportunities and government-funded services. These changes have a greater effect on an economy dependent on a single industry than on one that is more diversified and experiencing growth in other sectors.

Given the stable timber supply forecast for the Fort St. John TSA, the forest dependent areas should continue to benefit from, and rely on, forestry for a substantial portion of the income flowing into the region.

7.3.3 Nature, production capabilities and timber requirements of processing facilities

The Fort St. John TSA has two lumber mills, a chip mill, and a pulp mill. In 2000, these mills processed approximately 1.8 million cubic metres of timber. The timber supply for these mills comes from the Fort St. John TSA, and other nearby forest districts such as Dawson Creek. Construction of the joint Slocan-LP OSB plant will increase the volume of timber processed in the TSA by as much as 600 000 cubic metres per year. The regional supply of timber, in terms of volume, is able to provide local mills with sufficient timber.

7.3.4 Regional timber supply issues

The regional timber supply is an important consideration when examining potential future impacts associated with timber supply changes. The Prince George region supplies timber to mills throughout the northern half of the province and to some southern interior and coast mills.

Over the next 25 years, timber supply forecasts indicate that the average annual harvest in the Prince George Forest Region could remain relatively constant at 19 to 20 million cubic metres.[10] The Prince George Forest Region has the most stable timber supply in the province.

7.4 Summary

The oil and gas industry in the Fort St. John TSA is the leading source of employment and income for local residents, followed by the public sector and the travel sector (highly dependent on the temporary workforce of the oil and gas sector). Forestry supports approximately 9% of the area's labour force.

From 1999 to 2001, the volume of timber harvested in the Fort St. John TSA averaged approximately one million cubic metres per year, which is about 50% of the current AAC. This harvest has supported about 670 direct person-years of employment and a further 770 person-years of indirect and induced employment. Residents of the TSA accounted for about 62% of this total employment.

The current AAC of 2 015 000 cubic metres has been completely apportioned; however, not all operations are completely functional at this time. It is anticipated that when this AAC is fully harvested and processed, it will support about 1,350 person-years of direct forestry employment and a further 1,552 person-years of indirect and induced employment across the province. The employment income associated with this direct, indirect and induced employment would be about $116.9 million per year.

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(10) The current AAC for the Prince George Forest Region totals 19 400 299 cubic metres; by approximately 2020, current timber supply forecasts indicate that the timber supply in the Prince George region could be approximately 19.8 million cubic metres per year.

7 Socio—Economic Analysis

Increasing the timber supply to the projected level of 2 713 400 cubic metres per year would provide additional opportunities; however, it is uncertain if demand and processing capacity would increase to use this additional volume. Current employment and income levels can be expected to continue, given the stable timber supply indicated by the timber supply forecast and assuming accessibility of markets and market demand. Employment can be expected to increase with the development of the Slocan-LP oriented strandboard plant.

Based on the average 1999-2001 harvest, the provincial government currently collects about $37.2 million per year in stumpage and related payments, other industry taxes and provincial income taxes.

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9 Glossary

Allowable annual cut (AAC)	The rate of timber harvest permitted each year from a specified area of land, usually expressed as cubic metres of wood per year.
Analysis unit	A grouping of types of forest — for example, by species, site productivity, silvicultural treatment, age, and or location — done to simplify analysis and generation of timber yield tables.
Available volumes	The portion of total inventory volumes that is available for harvesting after all management constraints on timber harvesting have been considered, including definition of the timber harvesting land base, age of tree merchantability, deferrals, and any other priorities or constraints on timber harvesting.
Base case harvest forecast	The timber supply forecast which illustrates the effect of current forest management practices on the timber supply using the best available information, and which forms the reference point for sensitivity analysis.
Basic sector	Sectors of the economy, such as forestry, tourism and mining, that create flows of income into the region and are assumed to be drivers of the local economy. Non—basic sectors, such as retail outlets, are supported by basic sectors.
Biodiversity (biological diversity)	The diversity of plants, animals and other living organisms in all their forms and levels of organization, including the diversity of genes, species and ecosystems, as well as the evolutionary and functional processes that link them.
Biogeoclimatic (BEC) variant	A subdivision of a biogeoclimatic subzone. Variants reflect further differences in regional climate and are generally recognized for areas slightly drier, wetter, snowier, warmer or colder than other areas in the subzone.
Biogeoclimatic zones	A large geographic area with broadly homogeneous climate and similar dominant tree species.
Clearcutting with reserves	A variation of the clearcut silvicultural system in which trees are retained, either uniformly or in small groups, for purposes other than regeneration.
Coniferous	Coniferous trees have needles or scale—like leaves and are usually 'evergreen'.
Culmination age	The age at which a timber stand reaches its highest average growth rate, or mean annual increment (MAI). MAI is calculated as stand volume divided by stand age. Culmination age is the optimal biological rotation age to maximize long—term volume production from a growing site.

9 Glossary

Cultural heritage resource	An object, a site or the location of a traditional societal practice that is of historical, cultural or archaeological significance to the province, a community or an aboriginal people.
Cutblock adjacency	The desired spatial relationship among cutblocks. Most adjacency restrictions require that recently harvested areas must achieve a desired condition (green—up) before nearby or adjacent areas can be harvested. Specifications for the maximum allowable proportion of a forested landscape that does not meet green—up requirements are used to approximate the timber supply impacts of adjacency restrictions.
Deciduous	Deciduous trees shed their leaves annually and commonly have broad—leaves.
Employment coefficient	The number of person—years of employment supported by every 1000 cubic metres of timber harvested; for example, a coefficient of 1.0 indicates that every 1000 cubic metres harvested supports one person—year, or 500 000 cubic metres supports 500 person—years.
Employment multiplier	An estimate of the total employment supported by each direct job, for example a multiplier of 2.0 means that one direct job supports one additional indirect and induced job.
Environmentally sensitive areas	Areas with significant non—timber values, fragile or unstable soils, impediments to establishing a new tree crop, or high risk of avalanches.
Forest cover objectives	Specify desired distributions of areas by age or size class groupings. These objectives can be used to reflect desired conditions for wildlife, watershed protection, visual quality and other integrated resource management objectives. General adjacency and green—up guidelines are also specified using forest cover objectives (see **Cutblock adjacency and Green–up**).
Forest inventory	An assessment of British Columbia's timber resources. It includes computerized maps, a database describing the location and nature of forest cover, including size, age, timber volume, and species composition, and a description of other forest values such as recreation and visual quality.

9 Glossary

Forest Practices Code	Legislation, standards and guidebooks that govern forest practices and planning, with a focus on ensuring management for all forest values.
Free-growing	An established seedling of an acceptable commercial species that is free from growth—inhibiting brush, weed and excessive tree competition.
Green-up	The time needed after harvesting for a stand of trees to reach a desired condition (usually a specific height) — to ensure maintenance of water quality, wildlife habitat, soil stability or aesthetics — before harvesting is permitted in adjacent areas.
Growing stock	The volume estimate for all standing timber at a particular time.
Harvest forecast	The flow of potential timber harvests over time. A harvest forecast is usually a measure of the maximum timber supply that can be realized over time for a specified land base and set of management practices. It is a result of forest planning models and is affected by the size and productivity of the land base, the current growing stock, and management objectives, constraints and assumptions.
Indirect and induced jobs	Indirect jobs are supported by direct business purchases of goods and services. Induced jobs are supported by employee purchases of goods and services; for example, at retail outlets.
Integrated resource management (IRM)	The identification and consideration of all resource values, including social, economic and environmental needs, in resource planning and decision—making.
Land and Resource Management Plan (LRMP)	A strategic, multi—agency, integrated resource plan at the subregional level. It is based on the principles of enhanced public involvement, consideration of all resource values, consensus—based decision making, and resource sustainability.
Landscape-level biodiversity	The *Landscape Unit Planning Guide* provides objectives for maintaining biodiversity at both the landscape level and the stand level. At the landscape level, guidelines are provided for the maintenance of seral stage distribution, patch size distribution and landscape connectivity.

9 Glossary

Landscape unit	A planning area based on topographic or geographic features, that is appropriately sized (up to 100 000 hectares), and designed for application of landscape-level biodiversity objectives.
Long-term harvest level	A harvest level that can be maintained indefinitely given a particular forest management regime (which defines the timber harvesting land base, and objectives and guidelines for non-timber values) and estimates of timber growth and yield.
Management assumptions	Approximations of management objectives, priorities, constraints and other conditions needed to represent forest management actions in a forest planning model. These include, for example, the criteria for determining the timber harvesting land base, the specification of minimum harvestable ages, utilization levels, integrated resource guidelines and silviculture and pest management programs.
Mature seral	Forest stands with trees between 80 and 120 years old, depending on species, site conditions and biogeoclimatic zone.
Maximum modification VQO	Visible alterations are dominant and out of scale, but appear natural in the background. Up to 33% of the area can be visibly altered by harvesting activity (see **Visual quality objective**).
Mixed-wood	Forests that have a mix of coniferous and deciduous trees.
Model	An abstraction and simplification of reality constructed to help understand an actual system or problem. Forest managers and planners have made extensive use of models, such as maps, classification systems and yield projections, to help direct management activities.
Modification VQO	Visible alterations may dominate the landscape, but should blend with natural features. Up to 25% of the visible area can be altered by harvesting activity (see **Visual quality objective**).
Natural disturbance type (NDT)	An area that is characterized by a natural disturbance regime, such as wildfires, which affects the natural distribution of seral stages. For example areas subject to less frequent stand-initiating disturbances usually have more older forests.

Non-merchantable forest types	Stands that are accessible and otherwise available for harvesting but are assumed to be non-merchantable due to stand characteristics such as small piece size, incidence of decay, species composition and low stocking.
Not satisfactorily restocked (NSR) areas	An area not covered by a sufficient number of well—spaced trees of desirable species. Stocking standards are set by the B.C. Forest Service. Areas harvested prior to October 1987 and not yet sufficiently stocked according to standards are classified as backlog NSR. Areas harvested or otherwise disturbed since October 1987 are classified as current NSR.
Old seral	Old seral refers to forests with appropriate old forest characteristics. Ages vary depending on forest type and biogeoclimatic variant.
Operability	Classification of an area considered available for timber harvesting. Operability is determined using the terrain characteristics of the area as well as the quality and quantity of timber on the area.
Partial retention VQO	Alterations may be visible but not conspicuous. Up to 15% of the area can be visibly altered by harvesting activity (see **Visual quality objective**).
Partition	A portion of the AAC that is attributable to certain types of timber and/or terrain.
Person-year(s)	One person working the equivalent of one full year, defined as at least 180 days of work. Someone working full-time for 90 days accounts for 0.5 person-years.
Preservation VQO	Alterations are generally not visible. Up to 1% of the visible landscape can be visibly changed by harvesting activity. (see **Visual quality objective**).
Protected area	A designation for areas of land and water set aside to protect natural heritage, cultural heritage or recreational values (may include national park, provincial park, or ecological reserve designations).
Pruning	The manual removal of the lower branches of crop trees to a predetermined height to produce clear, knot-free wood.
Pulpwood agreements	An agreement applying to a fixed geographic area that allows harvesting of timber below sawlog standards if mill residues suitable for the facility under the agreement are not available.

9 Glossary

Retention VQO	Alterations are not easy to see. Up to 5% of the visible landscape can be altered by harvesting activity (see **Visual quality objective**).
Riparian area	Areas of land adjacent to wetlands or bodies of water such as swamps, streams, rivers or lakes.
Riparian habitat	The stream bank and flood plain area adjacent to streams or water bodies.
Scenic area	Any visually sensitive area or scenic landscape identified through a visual landscape inventory or planning process carried out or approved by a district manager.
Sensitivity analysis	A process used to examine how uncertainties about data and management practices could affect timber supply. Inputs to an analysis are changed, and the results are compared to a baseline or base case.
Seral stages	Sequential stages in the development of plant communities that successively occupy a site and replace each other over time.
Site index	A measure of site productivity. The indices are reported as the average height, in metres, that the tallest trees in a stand are expected to achieve at 50 years (age is measured at 1.3 metres above the ground). Site index curves have been developed for British Columbia's major commercial tree species.
Stand-level biodiversity	A stand is a relatively localized and homogeneous land unit that can be managed using a single set of treatments. In stands, objectives for biodiversity are met by maintaining specified stand structure (wildlife trees or patches), vegetation species composition and coarse woody debris levels.
Stocking	The proportion of an area occupied by trees, measured by the degree to which the crowns of adjacent trees touch, and the number of trees per hectare.
Table Interpolation Program for Stand Yields	A B.C. Forest Service computer program used to generate yield projections for managed stands based on interpolating from yield tables of a model (TASS) that simulates the growth of individual trees based on internal growth processes, crown competition, environmental factors and silvicultural practices.

Timber harvesting land base	Crown forest land within the timber supply area where timber harvesting is considered both acceptable and economically feasible, given objectives for all relevant forest values, existing timber quality, market values and applicable technology.
Timber supply	The amount of timber that is forecast to be available for harvesting over a specified time period, under a particular management regime.
Timber supply area (TSA)	An integrated resource management unit established in accordance with *Section 7* of the *Forest Act*.
Tree farm licence (TFL)	Provides rights to harvest timber, and outlines responsibilities for forest management, in a particular area.
Unsalvaged losses	The volume of timber killed or damaged annually by natural causes (e.g., fire, wind, insects and disease) that is not harvested.
Variable Density Yield Prediction model	An empirical yield prediction system supported by the Ministry of Sustainable Resource Management, designed to predict average yields and provide forest inventory updates over large areas (i.e., Timber Supply Areas). It is intended for use in unmanaged natural stands of pure or mixed species composition.
Visual quality objective (VQO)	Defines a level of acceptable landscape alteration resulting from timber harvesting and other activities. A number of visual quality classes have been defined on the basis of the maximum amount of alteration permitted.
Volume estimates (yield projections)	Estimates of yields from forest stands over time. Yield projections can be developed for stand volume, stand diameter or specific products, and for empirical (average stocking), normal (optimal stocking) or managed stands.
Wildlife tree	A standing live or dead tree with special characteristics that provide valuable habitat for conservation or enhancement of wildlife.
Woodlot licence	An agreement entered into under the *Forest Act*. It allows for small-scale forestry to be practised in a described area (Crown and private) on a sustained yield basis.

Appendix A

Description of Data Inputs and Assumptions for the Timber Supply Analysis

Introduction

In November of 2000 a data package for the Fort St. John Timber Supply Area (TSA) timber supply review was released for public review. As a result of public input and analysis of the databases, a number of data and management assumptions have been revised. This appendix presents the revised information used to produce the base case timber supply analysis.

The following tables and commentary outline the methods and inputs used to derive the timber harvesting land base, and to construct the timber supply model for the Fort St. John TSA timber supply analysis. This information represents current forest management in the area. Current management is defined as the set of land-use decisions and forest and stand management practices currently implemented and enforced. Future forest management objectives that may be intended, but are not currently implemented and enforced are not included in this appendix.

The purpose of the timber supply review is to provide information on the effects of current management on both short- and long-term timber supply in each timber supply area in the province. Any changes in forest management objectives and practices, and any changes in or improvements to the data will be included in subsequent timber supply analyses.

A.1 Inventory Information

Table A-1. lists the inventories that will be used to define the timber harvesting land base and to model forest management activities.

Table A-1. Inventory information

Data	Inventory source	Vintage	Update	Input scale
Forest cover inventory	Ministry of Forests (MoF)	Inventory year (% of TSA) 1964 (11%) 1969 (28%) 1971 (31%) 1989 (30%)	Dec. 31, 1999	1:20,000
The following inventories are Fort St. John Forest District non-standard inventory files				
Visual resource inventory - scenic areas, visual inventory VQOs	MoF	1997	1997	1:50,000
Biogeoclimatic ecosystem classification (BEC) zoning	MoF Research Branch	1997		1:250,000
Landscape units (LU)	MoF/Ministry of Sustainable Resource Management (MSRM)	1996	1999	1:20,000
Land and resource management plan (LRMP) resource management zones	MoF	1996		1:250,000
Class A parks	MSRM	1999		1:20,000
Forest roads	MoF	1999		1:20,000
Riparian buffers	MoF	1999		1:20,000
Grazing tenures	MoF		1999	1:50,000
Woodlot licences	MoF		1999	1:20,000
Pulpwood agreement boundaries:	MoF			
PA 12		1989		1:50,000
PA 13		1989	1996	1:20,000
Caribou management zones	MoF	1989		1:50,000
Operability	MoF	1998	2000	1:250,000
Recreation	MoF	1989	1998	1:20,000
Ownership	MoF	1989		1:20,000
Agriculture land reserve	MoF	1989	1999	1:250,000
Range burns	MoF / MSRM	1998	1998	1:250,000
Forest Development Plan	MoF	2001–2006	2001	1:20,000
Wildlife burns	MSRM	1999		1:50,000
Seismic roads and trails	Trim	1995	1999	1:50,000

A.1 Inventory Information

Data source and comments:

Forest inventory planning (FIP) and non-standard files are Arc/Info — TRIM based NAD83 in Albers projection. Harvesting and regeneration activities have been updated to December 31, 1999. The inventory file was projected for growth to December 31, 2000.

Biogeoclimatic ecosystem classification (BEC) zoning — updated from most recent file available from MoF Research Branch.

Landscape units — boundaries drafted by MoF/MSRM, realigned to TRIM and MSRM watershed atlas heights-of-land file.

Visual landscape inventory — scenic areas and visual quality objectives (VQOs) were updated in 1997 and are current to visual standards. Recreation inventory information has been developed as a separate file rather than using the standard recreation fields within the FIP file.

LRMP resource management zones — established by the LRMP Planning Table.

Protected areas (PA) — five protected areas to date (September 2001) have been designated under the *Parks Act*. There are three goal two areas that have not been declared by Order-in-Council.

Forest roads — Forest Road Management System (FRMS) completed in 1999 based on TRIM and TRIM II databases. Roads and other features such as seismic lines are plotted at a 1:20,000 scale and compiled to FRMS road classification scheme for the TSA. Seismic lines have been recorded and updated on separate TRIM and TRIM II databases.

Riparian buffers — using MoF, MSRM and Licensee data, riparian areas have been classified using the *Riparian Management Area Guidebook* standards for riparian management and reserve zones. Riparian buffers have been compiled on a non-standard layer using TRIM based spatial data for streams and the interim stream inventory data.

Grazing tenures — non-standard file derived from legal status maps (Exhibit A's). Information is current to June 2000.

Woodlot licences — non-standard file derived from legal status maps (Exhibit A's). Information is current to June 2000.

Pulpwood agreement 12 — boundaries have been transferred from 1:50,000 and 1:250,000 paper maps to 1:20,000 TRIM maps.

Pulpwood agreement 13 — boundaries have been transferred to 1:20,000 TRIM maps.

Caribou management zones — The inventory regions and compartments within the standard inventory file were used to delineate caribou management zones.

Operability — The operability classification refers to the harvesting system that would likely be employed based on soil type and slope. The classification was developed as a separate file rather than using the standard operability fields within the FIP file.

Ownership — this layer within the standard FIP file was used except for range burn, woodlot licence, grazing leases, community pastures, Class A Parks, pulpwood licences, grazing tenure and wildlife burn ownerships. For the listed items, data has been updated and recorded on non-standard ownership layers. The data for the standard ownership layers is no longer current. Limited resources and information precluded data preparation and transfer to the standard file layers.

Forest Development Plan — shows areas planned for harvest from 2001 to 2006.

A.1 Inventory Information

Additons/changes during processing of the inventory files

Some stands were missing timber supply block labels and these were manually assigned to the aggregate working file.

History information from the FIP file was not transferred to the aggregate working file. Data for logging or wildfire disturbance was retrieved and manually entered into the aggregate working file.

Riparian buffer, road buffer and utility corridors were developed as separate GIS layers. Aggregating this information on the working file generated too many resultant polygons for practical use in the analysis. To increase analysis efficiency, the per cent of each forest cover polygon area in each category (riparian, road, utility corridor) was assigned to the working file.

A.2 Zone and Analysis Unit Definitions

A.2.1 Management zones

Management zones represent areas with distinct management emphasis. For example, a zone may be based on a harvesting system, silviculture system, visual quality objective or wildlife consideration. Some areas may be subject to more than one management objective. Grouping enables the analyst to apply overlapping constraints to such areas.

Table A-2. provides general descriptions of the management objectives and related information to be tracked in the analysis. The non–contributing forest (i.e., forested land not available for timber harvesting) is included for consideration in attaining forest cover objectives for landscape-level biodiversity and visual quality. Further information on the forest cover requirements to be applied to these areas can be found in Section A.4.4, "Integrated resource management."

Table A-2. Objectives to be tracked

Consideration/issue	Description
Landscape–level biodiversity	Draft landscape unit (LU) boundaries and draft biodiversity emphasis objectives (BEO) were identified. Allows application of forest age related biodiversity requirements at the landscape unit/BEC zone variant level. All Crown forest is included. Facilitates reporting and tracking of old-seral targets.
Visual quality objectives (VQO)	To maintain forest cover consistent with each visual quality class in areas identified as visually sensitive within each landscape unit. Allows reporting on forest cover status.
Integrated resource management area	To maintain adjacency forest cover requirements at the landscape unit level through the application of green-up criteria. Reporting purposes to track forest cover status.
Caribou management area	Four areas have been identified. Three areas managed to maintain thermal forest cover (per cent of forest required to be above 100 years of age) and one area managed to maintain adjacency forest cover through the application of green-up criteria. Reporting purposes to track forest cover status.
Fort St. John LRMP	Reporting purposes to track forest cover status within each resource management zone. See Section A.4.4.1, "Forest cover requirements."
Protected areas	For future district use (reporting on forest cover, etc.).
Pulpwood agreements	Allows reporting on status and contribution of Pulpwood Agreements 12 and 13.
Timber supply block	Timber supply block area tracked for reporting purposes.
Range and wildlife burn area	Range and wildlife burn areas are managed to be in an early seral stage but are not included when assessing green-up requirements used to represent adjacency constraints. Reporting purposes to track forest cover status.
Fort St. John Forest Development Plan	The Fort St. John Forest Development Plan used to guide the short-term harvest in the base case.

Data source and comments:

See Section A.1, "Inventory information" for the sources of the management zone information referenced above.

A.2 Zone and Analysis Unit Definitions

A.2.2 Analysis unit characteristics

An analysis unit represents forest stands with similar tree species (as indicated by the inventory type group), similar timber growing capability (as indicated by the site index in the forest inventory file) and similar forest management regimes. Table A-3. lists the analysis units and their description. The amount of timber harvesting land base in each analysis unit is shown in Table A-16., "Minimum harvestable ages for the current timber harvesting land base."

Each analysis unit was assigned its own timber volume projection (growth curve). Yield tables for existing natural stands were derived using the variable density yield prediction (VDYP) yield model. Yield tables for recent plantations and future stands were derived using the table interpolation program for stand yields (TIPSY), batch version.

A.2 Zone and Analysis Unit Definitions

Table A–3. Definition of analysis units

Analysis unit	Analysis unit number	Inventory type groups	Description	Site index[a] range
Existing natural stands — conventional harvesting systems				
White Spruce-good-old[b]	11	21	Spruce composition > 80%	> 14.0
White Spruce-medium-old	12	21	Spruce composition > 80%	> 9.7 & ≤14.0
White Spruce-poor-old	13	18[c], 21	Spruce composition > 80%	≤9.7
White Spruce-good-young/thrifty[b]	14	18[c], 21	Spruce composition > 80%	> 15.5
White Spruce-medium-young/thrifty	15	18[c], 21	Spruce composition > 80%	> 9.7 & ≤15.5
White Spruce-poor-young/thrifty	16	18[c], 21	Spruce composition > 80%	≤9.7
Lodgepole Pine-all-old	21	28	Pine composition > 80%	All
Lodgepole Pine-good-thrifty	24	28	Pine composition > 80%	> 18.5
Lodgepole Pine-medium-thrifty	25	28	Pine composition > 80%	> 15.5 & ≤18.5
Lodgepole Pine-poor-thrifty	26	28	Pine composition > 80%	≤15.5
Lodgepole Pine-good/medium-young	28	28	Pine composition > 80%	> 14.0
Lodgepole Pine-poor-young	29	28	Pine composition > 80%	≤14.0
Small Lodgepole Pine-all-old	31	28	Pine composition > 80%, age > 80 and height 17.7 to 19.4 metres	All
Small Lodgepole Pine-good-thrifty	34	28	Pine composition > 80%, age > 80 and height 17.7-19.4 metres	> 12.5
Small Lodgepole Pine-medium/poor-thrifty	35	28	Pine composition > 80%, age > 80 and height 17.7-119.4 metres	≤12.5
Aspen-good-all	51	42	Aspen composition > 80%	> 21.0
Aspen-medium-all	52	42	Aspen composition > 80%	> 15.5 & ≤21.0
Aspen-poor-all	53	42	Aspen composition > 80%	≤15.5
White Spruce/Aspen-good-old	61	21, 26	Spruce ≤80% and Aspen is the secondary species	> 14.5
White Spruce/Aspen-medium/poor-old	62	21, 25, 26	Spruce ≤80% and Aspen is the secondary species	≤14.5
White Spruce/Aspen-good-young/thrifty	64	21,26	Spruce ≤80% and Aspen is the secondary species	> 18.0
White Spruce/Aspen-medium-young/thrifty	65	21, 25, 26	Spruce ≤80% and Aspen is the secondary species	> 14.5 & ≤18.0
White Spruce/Aspen-poor-young/thrifty	66	20[c],21, 25, 26	Spruce ≤80% and Aspen is the secondary species	≤14.5
White Spruce/Other-good-old	71	21, 24, 25, 26	Spruce ≤80% and Aspen is not the secondary species	> 14.0

(a) Site index is the expected tree height, in metres, at breast height at age 50 years.

(b) Old = '> 140' years of age, thrifty = '31 to 140' years of age, and young = ' ≤30' years of age.

(c) The subalpine fir inventory type groups (18, 20) formed a very small part of the timber harvesting land base. These stands were aggregated into the spruce analysis units.

(continued)

A.2 Zone and Analysis Unit Definitions

Table A–3. Definition of analysis units (continued)

Analysis unit	Analysis unit number	Inventory type groups	Description	Site index[a] range
White Spruce/Other-medium-old	72	20, 21, 22, 24, 25, 26	Spruce ≤80% and Aspen is not the secondary species	> 9.9 & ≤14.0
White Spruce/Other-poor-old	73	20, 21, 22, 24, 25, 26	Spruce ≤80% and Aspen is not the secondary species	≤9.9
White Spruce/Other-good-young/thrifty	74	20, 21, 22, 24, 25, 26	Spruce ≤80% and Aspen is not the secondary species	> 18.0
White Spruce/Other-medium-young/thrifty	75	20, 21, 22, 24, 25, 26	Spruce ≤80% and Aspen is not a secondary species	> 14.5 & ≤18.0
White Spruce/Other-poor-young/thrifty	76	20, 21, 22, 24, 25, 26	Spruce ≤80% and Aspen is not a secondary species	≤14.0
Lodgepole Pine/Aspen-all-old	81	30, 31	Pine ≤80% and Aspen is the secondary species	All
Lodgepole Pine/Aspen-good-young/thrifty	84	31	Pine ≤80% and Aspen is the secondary species	> 20.0
Lodgepole Pine/Aspen-medium-young/thrifty	85	30, 31	Pine ≤80% and Aspen is the secondary species	> 16.0 & ≤20.0
Lodgepole Pine/Aspen-poor-young/thrifty	86	30, 31	Pine ≤80% and Aspen is the secondary species	≤16.0
Lodgepole Pine/Other-good/medium-old	91	30, 31	Pine ≤80% and Aspen is not the secondary species	> 13.8
Lodgepole Pine/Other-poor-old	93	30	Pine ≤80% and Aspen is not the secondary species	≤13.8
Lodgepole Pine/Other-good-thrifty	94	30, 31	Pine ≤80% and Aspen is not the secondary species	> 17.0
Lodgepole Pine/Other-medium-thrifty	95	29, 30, 31	Pine ≤80% and Aspen is not the secondary species	> 13.8 & ≤17.0
Lodgepole Pine/Other-poor-thrifty	96	30, 31	Pine ≤80% and Aspen is not the secondary species	≤13.8
Lodgepole Pine/Other-all-young	97	30, 31	Pine ≤80% and Aspen is not the secondary species	All
Aspen/Spruce-good-all	101	41	Aspen ≤80% and Spruce is the secondary species	> 19.0
Aspen/Spruce-medium-all	102	41	Aspen ≤80% and Spruce is the secondary species	> 15.0 & ≤19.0
Aspen/Spruce-poor-all	103	41	Aspen ≤80% and Spruce is the secondary species	≤15.0
Aspen/Lodgepole pine-good-all	111	41	Aspen ≤80% and Pine is the secondary species	> 19.5
Aspen/Lodgepole pine-medium-all	112	41	Aspen ≤80% and Pine is the secondary species	> 15.0 & ≤19.5
Aspen/Lodgepole pine-poor-all	113	41	Aspen ≤80% and Pine is the secondary species	≤15.0

(a) Site index is the expected tree height, in metres, at breast height at age 50 years.

(b) Old = '> 140' years of age, thrifty = '31 to 140' years of age, and young = ' ≤30' years of age.

(c) The subalpine fir inventory type groups (18, 20) formed a very small part of the timber harvesting land base. These stands were aggregated into the spruce analysis units.

(continued)

A.2 Zone and Analysis Unit Definitions

Table A–3. Definition of analysis units (concluded)

Analysis unit	Analysis unit number	Inventory type groups	Description	Site index[a] range
Aspen/Mix-good-all	121	35, 41, 42	Aspen ≤80% and Pine/Spruce are not the secondary species	> 19.5
Aspen/Mix-medium-all	122	35, 36, 42	Aspen ≤80% and Pine/Spruce are not the secondary species	> 15.0 & ≤19.5
Aspen/Mix-poor-all	123	35, 36, 41, 42	Aspen ≤80% and Pine/Spruce are not the secondary species	≤15.0
Existing natural stands — unconventional (cable/helicopter) harvesting systems				
White Spruce-all-old	511	21	Spruce > 80% composition	All
White Spruce-all-thrifty/young	514	18[c], 21	Spruce > 80% composition	All
Lodgepole Pine/Mix-all-all	521	28,30,31	Pine ≤80% and any other secondary species	All
White Spruce/Mix-all-all	561	20, 21, 24, 25, 26	Pine ≤80% and any other secondary species	All
Current managed stands				
Conventional-White Spruce-all-all	1001	18[c], 21	Spruce > 80% composition	All
Conventional-Lodgepole Pine-all-all	1002	28	Pine > 80% composition	All
Conventional-White Spruce/Aspen-all-all	1006	26	Spruce ≤80% and Aspen is the secondary species	All
Conventional-White Spruce/Other-all-all	1007	20, 21, 22, 24, 25, 26	Spruce ≤80% and Aspen is not the secondary species	All
Conventional-Lodgepole Pine/Aspen-all-all	1008	31	Pine ≤80% and Aspen is the secondary species	All
Conventional-Lodgepole Pine/other-all-all	1009		Pine ≤80% and Aspen is not the secondary species	All
Unconventional-White Spruce-all-all	1551	21	Spruce > 80% composition	All
Unconventional-Lodgepole Pine/mix-all-all	1552	28, 30, 31	Pine ≤80% and any other secondary species	All
Unconventional-White Spruce/mix-all-all	1556	24, 25, 26	Spruce ≤80% and any other secondary species	All

(a) Site index is the expected tree height, in metres, at breast height at age 50 years.

(b) Old = '> 140' years of age, thrifty = '31 to 140' years of age, and young = ' ≤30' years of age.

(c) The subalpine fir inventory type groups (18, 20) formed a very small part of the timber harvesting land base. These stands were aggregated into the spruce analysis units.

Data source and comments:

Inventory type groups (assigned by the Ministry of Sustainable Resource Management, Terrestrial Information Branch) denote the dominant tree species as well as other species present.

After harvest, existing, non-managed stands were assigned to managed stand analysis units (see Table A-17. "Minimum harvestable ages for the future, managed timber harvesting land base."

A.3 Definition of the Timber Harvesting Land Base

The following sections describe the criteria used to define the timber harvesting land and are placed in the order in which the reductions were applied.

A.3.1 Land classified as non-forest or non-productive forest land

Alpine, lakes, rocks, etc., represented by inventory type identities 6 and 8 were excluded from the timber harvesting land base.

A.3.2 Woodlot licences

The total land base is stratified into various ownership codes. Ownership and character code '77N' usually identifies areas in woodlot licences but this mapping is outdated. The Fort St. John Forest District provided a separate inventory through a non-standard overlay for use in the timber supply analysis.

The AAC attributable to these areas is not included in the assessment of the current AAC for the Fort St. John TSA. At the time of the timber supply analysis the total volume allocated to woodlot licences was 32 904 cubic metres per year.

A.3.3 Land not managed by the British Columbia Forest Service

Areas where the provincial government has no jurisdiction such as private, municipal, and federal land, as well as Indian Reserves do not contribute to the Crown Forest. These areas are identified as ownership codes 40N to 54N, 61C/N and 81N. There are no Timber Licence (ownership codes 70 and 71) or Tree Farm Licence (TFL) areas within the database used in the analysis.

A.3.4 Range lease

A number of agricultural uses are not expected to contribute to the TSA timber supply. These uses are identified under the general label "range lease" on a non-standard overlay as the ownership information on the FIP file is outdated.

A.3.5 Parks and reserves

Provincial parks, ecological reserves and recreation areas (other ownership codes in 60 and 62N to 69N) and new parks (identified through an additional non-standard overlay) are not managed for timber, and were therefore excluded from the timber harvesting land base, but contribute to meeting landscape-level biodiversity objectives.

A.3.6 Total forested area managed by the British Columbia Forest Service (Crown forest)

Productive forest in ownership codes 62C (forest management unit) and 69C (forest reserves) contribute to the timber harvesting land base of the TSA. Agricultural land reserve (ALR), range permit and community pastures contribute to the timber harvesting land base and are identified through additional non–standard overlays (i.e., not the ownership information from the FIP file).

A.3.7 Non-commercial cover

Type identity code 5 represents areas currently occupied by non-commercial brush species. These areas are considered to be unlikely sites for timber production, and no rehabilitation of these sites is planned, thus they are removed from the land base considered available for timber supply.

A.3.8 Existing roads, trails and landings — utility corridor

Many features such as highways and railway lines have been inventoried as unique non–productive forest polygons. These features would be excluded from the harvestable land base as non–forest land. This section discusses the features or parts of features that have not been inventoried.

Separate estimates were made to reflect the loss in productive forest due to construction of existing and future roads, trails and landings (RTL). Other features include seismic lines, power and pipelines, railways, and well sites not captured in the FIP file. Existing RTL estimates are applied as reductions to the current productive forest considered available for harvesting and future RTL reductions are applied after stands are harvested for the first time in the simulation model.

Existing roads, trails, landings and other features have been mapped as a non–standard geographic information system (GIS) file. The features and the associated reductions to the timber harvesting land base are shown in Table A-4.

Table A-4. Estimates for existing roads, trails, landings and other features

Type	Buffer width or area	Group type
Roads		
Alaska highway	90 metres	Major road
Hudson Hope highway	60 metres	Major road
All other secondary highways	25 metres	Major road
Municipal roads	25 metres	Major road
Forest Service roads	20 metres	Major road
Petroleum development roads	20 metres	Major road
Non-status roads	20 metres	Minor road
Other roads	20 metres	Minor road
Cut permit roads	10metres	Minor road
Road permit roads	20 metres	Minor road
Other		
Railways	20 metres	Major road
Trails	5 metres	Minor road
Seismic lines	7 metres	Utility corridor
Power lines	20 metres	Utility corridor
Pipelines	18 metres	Utility corridor

For the timber supply analysis, the data from the features non-standard overlay was compiled as a per cent of the total stand polygon area by group type shown in Table A-4. The data was also compiled in order of major road, minor road and utility corridor to prevent "double counting" polygon area.

Well sites (3684 hectares) have been mapped as a separate non-standard overlay and a count of well sites by mapsheet and polygon was provided for the timber supply analysis. Since the data was not spatial, the analyst could not estimate how much area of the well sites would overlap with other land base reductions. Consequently, no reductions were made for well sites in the analysis.

District staff estimate the average area of a well site to be 1.2 hectares. Therefore, the timber harvesting land base could be overestimated by as much as 4421 hectares.

Data source and comments:

For the timber supply analysis, the data for the current roads, trail and other features was provided as a per cent of the total stand polygon area. This required the reduction to be made early during the land base derivation (i.e., prior to any partial polygon or total/partial resultant reductions) since the initial reference was the entire polygon area).

Existing roads have been classified according to the Fort St. John TSA's Forest Road Management System (FRMS).

Seismic lines have been mapped and buffered on both TRIM I and TRIM II mapping.

A.3.9 Riparian reserve and management zones

Lake, riparian and wetlands no-harvest area

Lake and wetlands no-harvest areas have been mapped as a non-standard geographic information system (GIS) file. The features and the associated reductions to the timber harvesting land base are shown in Table A-5.

Table A–5. Riparian areas — wetlands[a] and lakes

Wetland or lake class	Area (hectares)	Reserve width (metres)	Management zone width[b] (metres)	Total buffer width reduction (metres)	Group type
Wetland — W1	> 5	10	40	30	Wetland
Wetland — W3	1–5	0	30	15	Wetland
Lakes — all classes combined	—	—	—	15	Lake

(a) Wetlands are limited to those features labeled as swamps in FC1 file.

(b) Fifty per cent of the management zone is removed from the timber harvesting land base.

River and streams

Detailed stream inventories were not available for most of the Fort St. John TSA, therefore streams were classified into four categories using a combination of available stream inventories and Terrain Resource Information Management (TRIM) maps. The no-harvest areas were mapped as a non-standard geographic information system (GIS) file. Table A-6. shows the four categories and the buffer widths that were applied to these rivers and streams.

Table A-6. River and stream categories for the Fort St. John TSA

River or stream class	Description	Buffer width (metres)[a]	Group type
S1 large rivers	Peace River	100	River/stream
S1 (except large rivers)	Rivers that appear as double lines on TRIM maps.	60	River/stream
Fish-bearing streams	Rivers and streams classified as S2, S3 and S4 on stream inventories. Rivers and streams on TRIM maps that are depicted by a single line, are classified as "definite" streams and have a slope less than or equal to 20%.	20	River/stream
Non-fish-bearing streams	Rivers and streams classified as S5 and S6 on stream inventories. Rivers and streams on TRIM maps that are depicted by a single line, are not classified as "definite" streams and have a slope that is greater than 20%.	5	River/stream

(a) Data were mapped for the riparian stream and river areas by applying buffers which include the reserve plus 50% of the width of the management zone. Current practice indicates that, on average, one–half of the management zone is clearcut harvested.

There are no community watersheds within the Fort St. John TSA.

For the timber supply analysis, the data from the features non–standard overlays was compiled as a per cent of the total stand polygon area by group type shown in Table A-5. and Table A-6. The data was also compiled in conjunction with major road, minor road and utility corridor to prevent "double-counting" polygon area.

A.3.10 Range and wildlife burn areas

Some forest lands are kept in an early seral stage through regular controlled burns for range and wildlife management. These areas do not contribute to the timber supply in the Fort St. John TSA and were not included when assessing adjacency or visual quality objective forest cover requirements. Within the TSA there are 28 203 hectares of range burn, 16 669 hectares of wildlife burn and 868 hectares with both range and wildlife burn areas.

Range and wildlife burn areas have been mapped as non-standard geographic information system (GIS) files.

Analysis of the stand polygons on the forest inventory planning file showed that stand ages have not been updated to reflect the early seral stage conditions. During the running of the timber supply, stand age was re-assigned (transfer) to age 20 over the first thirty-year period. Thereafter, any stand with an age of 60 within range and wildlife burn areas was re-assigned to age 20.

A.3.11 Geographically defined areas — economic accessibility

Within the Fort St. John TSA, areas in the north-west timber supply blocks have poor access to merchantable stands and the delivered wood cost exceeds the value of the timber. Table A-7. shows the location of the stands that are not economically accessible.

Table A–7. Exclusion of specific, geographically defined areas

Region	Compartment	Area reduction (%)
78	104	100
78	105	100
79	178	100
79	182	100
79	183	100

A.3.12 Inoperable areas

In the Fort St. John TSA, areas were defined as inoperable based on isolation or existence of physical barriers such as steep slopes. These areas were first identified through aerial photo interpretation and classified as inoperable (I) on a non-standard file. In the analysis, inoperable areas were removed from the timber harvesting land base.

The remaining areas were assigned an operability classification based on slope, soil/parent material and harvest system. Table A-8. describes the operability types.

Table A–8. Description of operability types in the Fort St. John TSA

Harvest system	Slope %	Soils type	Operability code
Conventional (ground)	0–30	Lacustrine	A
Conventional (ground)	0–55	Non–lacustrine	A
Cable	31–100	Lacustrine	C
Cable	56–100	Non–lacustrine	C
Cable/aerial	100+	All soil types	H

Data source and comments:

Stands or groupings of stands less than four hectares in size were amalgamated into the largest adjacent operability classification.

The physical operability database for the analysis is based on broad operability criteria. Mapping by finer slope or soils sub-types is available but is only used in field operations

A.3.13 Non-merchantable forest types

Non-merchantable forest types are physically operable stands that exceed low site criteria but that are not currently utilized or have marginal merchantability. Also, merchantability may be limited by the amount of a particular species within a stand. Table A-9. shows the criteria for non-merchantable stands within the Fort St. John TSA.

Table A-9. Non–merchantable stand criteria

Leading species	Inventory type group	Stand characteristics	Reduction per cent (%)
Sb	21-26	All	100
Hw, Cw	10, 16	All	100
Aspen	41	Aspen < 30%	100
Birch	40	All	100
Deciduous other than Aspen	35, 36, 37,38, 41, 42	Cottonwood > 49% — except NSR stands	100
Larch	33--34	All	100
Deciduous with Sb	35, 37, 41	Sb > 30% as a secondary species	100
Deciduous	35-42	Less than 50% commercial species (Sw, Pl, At, Bl)	100
Deciduous	35-42	All deciduous-leading stands in the cable/helicopter land base[a]	100

(a) Cottonwood, deciduous and aspen-leading analysis units are limited to conventional harvest systems.

A.3.14 Sites with low productivity

Sites may have low productivity either because of inherent site factors (nutrient availability, exposure, excessive moisture, etc.), or because the sites are not fully stocked with commercial tree species. Typically, these stands with low productivity are intermixed with other stands within the forested land base. Because they are not considered to be harvestable, these stands need to be identified and removed from the timber harvesting land base.

Separate criteria for low productivity were developed for younger and older stands in the Fort St. John TSA. Criteria are further refined by analysis unit. For stands within the analysis units that are older than a specified age, low productivity is based solely on meeting or exceeding minimum height and volume criteria. Table A-10. shows the criteria used in the analysis for older stands.

A.3 Definition of the Timber Harvesting Land Base

Table A-10. Description of sites with low timber growing potential — older stands

Leading species	Inventory type group	Criteria for older stands			Reduction per cent (%)
		Age (years)	Volume (m^3/hectares)	Height (metres)	
Conventional harvest systems					
White spruce	21-26	≥ 120	< 140	< 17.5	100
Pine	28-31	≥ 80	< 140	< 19.4	100
Small pine	28-31	≥ 80	< 140	< 17.7	100
Subalpine fir	18-20	≥ 120	< 140	< 17.5	100
Aspen	41-42	≥ 101	< 120	< 17.5	100
Other deciduous	35-38	≥ 101	< 120	< 17.5	100
Cable/helicopter harvest systems					
Spruce	21-26	≥ 120	< 250	< 17.5	100
Pine	28-31	≥ 80	< 250	< 19.5	100
Balsam	18-20	≥ 120	< 250	< 17.5	100

For younger stands, productivity is defined by growth potential or site index (SI). Minimum SI was derived for each analysis unit based on achievement of height and volume criteria by a specified age, as defined in Table A-10. Table A-11. (next page) lists the criteria used to define sites with low timber growth growing potential for younger stands.

Table A-11. Description of sites with low timber growing potential — younger stands

Leading species and — secondary species (where applicable)	Inventory type group	Criteria for younger stands: Age (years)	Criteria for younger stands: Estimated SI to meet minimum older stand criteria (metres)	Reduction per cent (%)
Conventional harvest systems				
Spruce	21	< 121	9.7	100
Spruce — Aspen	22-26	< 121	10.5	100
Spruce — not Aspen	22-26	< 121	9.9	100
Subalpine fir	18	< 121	10.6	100
Subalpine fir — not Aspen	19-20	< 121	11.0	100
Pine	28	< 81	13.9	100
Pine — Aspen	29-31	< 81	16.0	100
Pine — not aspen	29-31	< 81	13.8	100
Small pine			Not applicable	
Aspen	41-42	< 101	14.7	100
Aspen — Pine	41-42	< 101	13.0	100
Aspen — Spruce	41-42	< 101	12.9	100
Cottonwood	35-36	< 101	9.6	100
Remaining deciduous with > 20% black spruce	35-42	< 101	14.3	100
Cable/helicopter harvest systems				
All subalpine fir	18-20	< 121	14.0	100
Pine	28	< 81	19.0	100
Pine — Aspen	29-31	< 81	22.1	100
Pine — not Aspen	29-31	< 81	18.8	100
Spruce	21	< 121	13.7	100
Spruce — Aspen	22-26	< 121	15.1	100
Spruce — not Aspen	22-26	< 121	13.2	100

A.3.15 Recreation feature reduction

A recreation feature inventory has been completed for the Fort St. John TSA. This inventory updates and replaces ESA recreation data. Table A-12. presents the per cent area exclusions for features, by significance and management class, found within the timber supply area.

Table A–12. Per cent area exclusions by recreation feature significance and management class

Feature significance	**Management class**		
	0 Very sensitive	**1 Sensitive**	**2 Not sensitive**
A. Very high recreational value	100	50	N/A
B. High recreational value	100	50	N/A
C. Moderate recreational value	100	20	0
D. Common recreational value	0	0	0

Three management classes are used to describe the feature sensitivity of recreation inventory polygons. The classes are:

Very sensitive — outstanding recreational, educational, scientific or heritage values;

Sensitive — requires special management considerations;

Not sensitive — normal forest management practices.

This feature information updates and replaces ESA recreation land base reductions.

A.3.16 Environmentally sensitive areas

Some forest lands are environmentally sensitive and/or significantly valuable for other resources. Many of these areas are identified and delineated during a forest inventory as environmentally sensitive areas (ESAs). ESAs that were delineated for use in the timber supply analysis are: areas with sensitive soils (Es), areas with regeneration problems (Ep), avalanche areas (Ea), and areas with wildlife values (Ew). Two ESA levels are recognized in the database: (1) high sensitivity and (2) moderate sensitivity. Table A-13., shows the criteria used to account for environmentally sensitive areas in which harvesting is not expected to occur.

Table A–13. Description of environmentally sensitive areas

ESA category	ESA description	Area reduction factor %
Es1	Areas with severe soil and steepness problems. Areas with actual or potentially unstable soils that may deteriorate unacceptably after forest harvesting. High constraint.	90
Es2	Areas with moderate soil and steepness problems. Areas with actual or potentially unstable soils that may deteriorate unacceptably after forest harvesting. Moderate constraint.	50
Ep (1 & 2)	Areas with severe regeneration problems. Areas with actual or potential critical regeneration problems.	90
Ea	Areas with severe snow chute and avalanche problems. Areas intended to protect man-made structures and valuable natural resources from snow avalanches.	90
Ew1	Areas of critical importance to wildlife. Areas with significant value for food, shelter or reproduction for wildlife. High constraint.	90
Ew2	Areas where wildlife values are important but less than Ew1. Moderate constraint.	30

A.3.17 Wildlife habitat reductions

Some wildlife habitat areas may be within land base already excluded from timber harvesting activities and do not require further consideration (e.g., ESAs and riparian reserves). Other areas can be managed by situating wildlife tree patches(WTP) around them (see Section A.4.4.2, "Wildlife tree patches"). Aside from areas already removed in these categories there are no other land base reductions for wildlife habitat in the analysis.

In February 1999, the government released the *Identified Wildlife Management Strategy*. The goals of the strategy are to minimize the impacts of forest practices on identified wildlife through the establishment of wildlife habitat areas and implementation of general wildlife measures. To date, no wildlife habitat areas have been established in the TSA.

A.3.18 Non-productive burn areas

In the past there have been large wildfires in the Fort St. John TSA. Many of the burn areas were mapped as large not satisfactorily restocked (NSR) polygons. As noted in the chief forester's last AAC rationale for the TSA; area within many of these polygons is actually non-commercial brush or non–productive forest. A survey differentiating forest from the non-forest has been performed. Results showed that 52 400 hectares of a total 94 500 hectares are productive forest area (55.4%).

The results of the survey were not incorporated into the inventory for this analysis. For this analysis the following assumptions were made to account for non-productive burn areas:

- 44.6% of the NSR area that has a fire disturbance history was removed from the timber harvesting land base;
- of the area with a fire disturbance history, only stands with default inventory type group codes (ITG = 28 and ITG source code = D) are partially excluded from the timber harvesting land base.

A.3.19 Cultural heritage resource reductions

An archaeological overview assessment (AOA) of the Fort St. John TSA was completed in 1996. This assessment is currently being refined to increase its operational utility. As part of their operational planning, the major licensees and the Small Business Forest Enterprise Program (SBFEP) complete additional archaeological and cultural heritage assessments when developing cutting permits and as directed by the District Manager.

Archaeological and cultural heritage site data are collected on an ongoing basis in operational planning. To date, no significant impact on timber supply has been identified.

A.3.20 Future roads trails and other features

Forest district staff estimate that most of the current roads, trails and other features reductions are from stands under the age of thirty. Therefore, future roads, trails, landings and other features have been estimated by calculating the per cent current area reduction to the timber harvesting land base, and applying that per cent (0.63%) to all stands currently greater than the age of thirty after their first harvest. The area within current seismic lines was not excluded from the timber harvesting land base, based in input provided by the Oil and Gas Commission, which indicates that net future reductions should be minor, given that existing lines will be used wherever possible, and that some lines will become re-forested.

A.4 Forest Management Assumptions

A.4.1 Harvesting

A.4.1.1 Utilization levels

The utilization levels define the maximum stump height, minimum top diameter inside bark (dib) and minimum diameter at breast height (dbh) by species and were used in the analysis to calculate merchantable volume. Table A-14. shows the standards and licence requirements currently in place for wood utilization in the Fort St. John TSA that were used to develop yield curves for the analysis.

Table A–14. Utilization levels

	Utilization		
Analysis unit	**Minimum dbh (cm)**	**Maximum stump height (cm)**	**Minimum top dib (cm)**
Spruce	17.5	30	10
Subalpine fir	17.5	30	10
Pine	12.5	30	10
Small pine	12.5	30	7.5[a]
Aspen	12.5	30	10
Cottonwood	12.5	30	10
Deciduous	12.5	30	10

(a) Minimum top reflects current performance. However, due to modelling limitations a top diameter of 10 centimetres were used in the VDYP model. Supplemental assessments show the difference in merchantable volume to be small for the species types at the TSA level.

A.4.1.2 Volume exclusions for mixed species stands

Larch and birch were excluded from the estimation of volume in all stands.

A.4.1.3 Minimum harvestable age derivation

The minimum harvestable age (MHA) is the time required for stands to grow to harvestable size; it defines the lower limit for harvesting. Harvesting may occur in stands at the minimum age to meet a harvest target for a short period of time to avoid large or abrupt changes in harvest levels. However, most stands will not be harvested until well past the minimum timber production ages because of management objectives for other resource values (e.g., requirements for the retention of older forest for biodiversity). Table A-15. shows the criteria for minimum harvestable age by leading species.

A.4 Forest Management Assumptions

Table A–15. Minimum harvestable age criteria

	Minimum criteria		
Leading species	**Height class**	**Average diameter (cm)**	**Volume (m³/hectares)**
Conventional land base			
Spruce leading		17.5	> 140
Pine leading	3+ (≥ 19.5 m)	12.5	> 140
Small pine	2 (10.5–19.4 m)		> 140
Aspen leading		12.5	> 120
Cable/aerial land base			
Spruce leading		17.5	> 250
Pine leading	3+ (≥ 19.5 m)	12.5	> 250

Table A-16. (next page) shows the minimum harvestable ages (MHA) for the current stand yield tables (analysis units). Culmination age for each analysis unit is shown to as a reference, to allow comparison of MHA to the age at which average stand growth is at its' maximum.

Table A–16. Minimum harvestable ages for the current timber harvesting land base

Analysis unit and analysis unit	#	Average site index (metres)	Area (hectares)	Culmination age (years)	Minimum harvestable age (years)
Existing natural stands — conventional harvest systems					
White spruce-good-old	11	16.88	14 931.6	110	72
White spruce-medium-old	12	12.48	13 081.0	150	97
White spruce-poor-old	13	6.85	35 804.2	260	169
White spruce-good-young/thrifty	14	18.29	35 488.2	100	67
White spruce-medium-young/thrifty	15	12.54	26 057.7	140	93
White spruce-poor-young/thrifty	16	9.30	2 854.0	190	127
Lodgepole pine-all-old	21	14.83	4 389.5	120	74
Lodgepole pine-good-thrifty	24	20.18	25 244.6	90	51
Lodgepole pine-medium-thrifty	25	16.80	48 898.9	110	64
Lodgepole pine-poor-thrifty	26	14.75	25 700.7	120	74
Lodgepole pine-good/medium-young	28	16.23	2 346.0	110	66
Lodgepole pine-poor/young	29	10.88	4 257.5	130	104
Small Lodgepole pine-all-old	31	10.03	3 372.8	140	120
Small Lodgepole pine-good-thrifty	34	13.10	32 126.3	130	88
Small Lodgepole pine-medium/poor-thrifty	35	11.28	21 199.9	130	105
Aspen-good-all	51	22.83	20 277.2	80	58
Aspen-medium-all	52	17.98	136 960.3	90	78
Aspen-poor-all	53	14.08	21 876.1	100	114
White spruce/aspen-good-old	61	15.99	9 208.1	120	81
White spruce/aspen-medium/poor-old	62	11.88	5 730.8	150	108
White spruce/aspen-good-young/thrifty	64	20.34	16 311.7	100	66
White spruce/aspen-medium-young/thrifty	65	16.08	29 099.6	120	79
White spruce/aspen-poor-young/thrifty	66	12.23	14 701.2	150	102
White spruce/other-good-old	71	15.70	9 854.8	130	79
White spruce/other-medium-old	72	12.10	7 948.3	150	100
White spruce/other-poor-old	73	7.50	15 396.9	230	153
White spruce/other-good-young/thrifty	74	20.87	13 469.2	100	63
White spruce/other-medium-young/thrifty	75	15.78	31 790.6	130	79
White spruce/other-poor-young/thrifty	76	11.71	29 767.4	150	102
Lodgepole pine/aspen-all-old	81	15.49	4 226.2	110	83
Lodgepole pine/aspen-good-young/thrifty	84	21.99	8 678.3	80	53
Lodgepole pine/aspen-medium-young/thrifty	85	18.21	34 002.0	100	67
Lodgepole pine/aspen-poor-young/thrifty	86	15.28	25 143.0	110	83

(continued)

Table A–16. Minimum harvestable ages for the current timber harvesting land base (concluded)

Analysis unit and analysis unit	#	Average site index (metres)	Area (hectares)	Culmination age (years)	Minimum harvestable age (years)
Lodgepole pine/other-good/medium-old	91	16.25	5 128.6	100	67
Lodgepole pine/other-poor-old	93	11.11	3 847.1	130	109
Lodgepole pine/other-good-thrifty	94	18.65	15 456.7	90	55
Lodgepole pine/other-medium-thrifty	95	15.43	45 369.0	100	71
Lodgepole pine/other-poor-thrifty	96	11.93	46 462.5	130	103
Lodgepole pine/other-all-young	97	13.14	8 348.8	100	69
Aspen/spruce-good-all	101	21.01	15 589.5	90	60
Aspen/spruce-medium-all	102	17.24	32 751.8	100	76
Aspen/spruce-poor-all	103	13.62	14 246.7	110	107
Aspen/Lodgepole pine-good-all	111	20.96	12 968.1	90	58
Aspen/Lodgepole pine-medium-all	112	17.26	25 251.4	100	74
Aspen/Lodgepole pine-poor-all	113	13.73	13 411.3	110	107
Aspen/mix-good-all	121	21.43	7 447.9	80	61
Aspen/mix-medium-all	122	17.47	18 656.7	90	78
Aspen/mix-poor-all	123	13.76	3 781.1	100	104
Existing natural stands — unconventional (cable/helicopter) harvesting systems					
White spruce-all-old	511	12.21	1 542.2	150	147
White spruce-all-thrifty/young	514	17.39	1 782.4	110	98
Lodgepole pine/mix-all-all	521	17.10	1 410.2	110	98
White spruce/mix-all-all	561	16.25	3 759.0	130	110
Current managed stands					
White spruce-all-all	1001	14.67	24 233.4	120	78
Lodgepole pine-all-all	1002	13.93	7 533.1	120	73
Aspen	1005	15.13	2 100.0	100	114
White spruce/aspen-all-all	1006	16.15	5 744.5	120	81
White spruce/other-all-all	1007	15.82	7 856.0	130	81
Lodgepole pine/aspen-all-all	1008	16.40	1 443.4	100	77
Lodgepole pine/other-all-all	1009	16.21	1 236.5	100	69
Unconventional-white spruce-all-all	1551	15.04	87.5	130	115
Unconventional-Lodgepole pine/mix-all-all	1552	12.35	758.0	100	108
Unconventional-white spruce/mix-all-all	1556	15.30	141.6	130	113
Average site index and timber harvesting land base		15.68	1 058 539.0		

A.4 Forest Management Assumptions

After current stands are harvested, a number of current analysis units are aggregated into single units. Aggregation is based on similar silvicultural prescriptions and site index. Also the age groups (i.e., young, thrifty and old) were eliminated for future managed stands. Table A-17. shows the minimum harvestable ages for the managed stand yield tables.

Table A-17. Minimum harvestable ages for the future, managed timber harvesting land base

Analysis unit — major species	Current analysis unit number	Managed analysis unit number	Average site index (metres)	Culmination age (years)	Minimum harvestable age (years)
Conventional harvest systems					
White spruce	1001	1001	14.67	120	71
White spruce	11	2011	16.88	100	61
White spruce	12, 15	2012	12.51	140	85
White spruce	13, 16	2013	7.03	240	151
White spruce	14	2014	18.29	90	56
Lodgepole pine	1002	1002	13.93	110	69
Lodgepole pine	21	2021	14.83	110	68
Lodgepole pine	24	2024	20.18	60	49
Lodgepole pine	25, 28	2025	16.77	80	51
Lodgepole pine	26	2026	14.75	90	62
Lodgepole pine	29	2029	10.88	130	103
Small Lodgepole pine	31	2031	10.03	130	118
Small Lodgepole pine	34	2034	13.10	100	75
Small Lodgepole pine	35	2035	11.28	130	96
Aspen	51	1051	22.83	80	58
Aspen	52	1052	17.98	90	78
Aspen	53, 1005	1053	14.17	100	114
White spruce/mix	64, 74	2064	20.58	80	53
White spruce/mix	61, 65, 1006	2061	16.09	110	69
White spruce/mix	71, 75, 1007	1056	15.77	110	94
White spruce/mix	62, 66, 72, 76	2076	11.91	150	98
White spruce/mix	73	2073	7.50	210	148
Lodgepole pine/mix	91, 1008, 1009	1009	16.40	110	78
Lodgepole pine/mix	81,86,95	2081	15.35	110	73
Lodgepole pine/mix	84	2084	21.99	80	48
Lodgepole pine/mix	85, 94	2085	18.35	90	59
Lodgepole pine/mix	93,96	2093	11.88	150	98
Lodgepole pine/mix	97	2097	13.14	130	88

(continued)

Table A-17. Minimum harvestable ages for the future, managed timber harvesting land base (concluded)

Analysis unit — major species	Current analysis unit number	Managed analysis unit number	Average site index (metres)	Culmination age (years)	Minimum harvestable age (years)
Aspen/mix	101, 111, 121	2101	21.08	80	63
Aspen/mix	102, 112, 122	2102	17.30	100	77
Aspen/mix	103, 113, 123	2103	13.68	120	94
Unconventional (cable/helicopter) harvesting systems					
Lodgepole pine/mix	1552	2552	11.88	150	98
Lodgepole pine/mix	521	2521	17.10	110	78
White spruce	514	2514	17.39	100	76
White spruce	1551	2551	15.04	120	90
White spruce	511	2511	12.21	140	108
White spruce/mix	561	2561	16.25	110	69
White spruce/mix	1556	1556	15.30	110	71

A.4.1.4 Harvest scheduling rules and priorities

Generally, the harvest queue was based on the random harvest rule. The stands allocated in the development plan have first priority for harvest for the first 20 years. Within the conifer analysis units, a second priority was to harvest pine stands greater than age 120, and spruce stands greater than age 140. A third priority was to harvest stands greater than culmination age. The deciduous harvest flow had no additional harvest priorities beyond the priority to harvest stands in the development plan first.

This timber supply analysis showed the small pine harvest separate from the remainder of the coniferous harvest. District staff estimate the current small pine harvest to be 10% of the total conifer AAC (i.e., 110 000 cubic metres per year). This level was used as the initial harvest level for this component of the base case.

A.4.1.5 Silvicultural systems

Clearcutting with reserves for wildlife tree patches is the only silvicultural system currently used on an operational scale in the Fort St. John TSA. Some small-scale selection silvicultural systems have been tried to date but they represent an insignificant portion of the projected future fibre supply.

In some areas, block design is important to reduce visual quality impacts. While this has not been captured explicitly in the timber supply modelling (forest cover requirements for VQOs were applied), this is an important aspect of ground or operational management within the TSA.

A.4.2 Unsalvaged losses

Table A-18. shows the estimated average annual salvaged and unsalvaged volumes resulting from damage by catastrophic events such as fire, insect epidemic and wind, on the timber harvesting land base. The unsalvaged loss column reflects only those areas on which the volume is not expected to be recovered or salvaged. For the most part, monitoring losses has been restricted to the coniferous component of the TSA as the harvest history and monitoring of unsalvaged deciduous species has started only recently in the TSA. There are no known causes of large-scale losses in deciduous stands at this time.

Table A-18. Unsalvaged losses[a] — timber harvesting land base

Location	Cause of loss	Total loss (m^3/year)	Net salvaged (m^3/year)	Annual unsalvaged loss (m^3/year)
Entire Fort St. John TSA	Insect	0	0	0
Entire Fort St. John TSA	Fire	32 700	2 200	30 500
Entire Fort St. John TSA	Wind	10 000	3 000	7 000
Total		42 700	5 200	37 500

(a) Estimates have been revised as a result of public consultation. The initial fire loss has been pro-rated to the timber harvesting land base (Total fire loss * timber harvesting land base area /total TSA area or 144 571 cubic metres per year * 1 058 540 hectares / 4 676 600 hectares = 22.635% = 32 700 cubic metres per year).

Data source and comments:

No areas in the TSA have suffered large losses of volume due to epidemic pest populations. While smaller areas do exist, impacts have not been sufficient to warrant mapping and impact evaluation. Maintenance of well-distributed younger stands is credited for minimal pest losses.

Losses from fire are based on volume losses reported in the *Ministry of Forests General Fire Summary on the Protection Information System for January 1984 to December 1997.*

Forest district staff believe that easily accessible windthrow within the timber harvesting land base is salvaged. Small pockets have and will continue to remain unsalvaged. Losses in the inaccessible or remote parts of the TSA have not been accounted for since they are outside the timber harvesting land base.

Forest district staff are currently updating the unsalvaged losses using the recent *Unsalvaged Loss Guidelines* produced by the Forest Practices Branch.

A.4.3 Silviculture

A.4.3.1 Regeneration activities in managed stands

The silviculture program consists of the mix of treatments expected to be carried out to achieve basic silviculture on all sites. Table A-19. shows the proportion of each analysis unit to be treated under each silviculture regime.

Recent conifer plantations and future stands have been projected using managed stand yield tables (MSYTs) produced using the Ministry of Forests' table interpolation program for stand yields (TIPSY) growth model. The volume of the deciduous component of mixed-wood and deciduous stands has been estimated using the VDYP model. MSYTs were built from a number of tables when more than one regeneration method is planned within an analysis unit. When this was the case, tables were produced for the different regeneration methods (each method and species combination) and then combined into one table.

A.4 Forest Management Assumptions

Table A-19. Regeneration assumptions by analysis unit

Analysis unit	Species composition	OAFs (%)		Regen delay	Regen method		Species		Density (stems/hectare)	
		1	2	(years)	Type	(%)	Code	%	Initial	Thin
1001, 2011, 2012, 2013, 2014, 2514, 2551, 2511	S leading conifer	15	5	2	Art	100	Sx	90	1400	
							Pl	10	1600	
1002, 2021, 2024, 2025, 2026, 2029	Pl leading conifer	15	5	2	Art	90	Pl	90	1600	
							Sx	10	1400	
				2	Nat	10	Pl	100	10000	1600
2031, 2034, 2035	Small pine conifer	15	5	2	Art	95	Pl	90	1600	
							Sx	10	1400	
				2	Nat	5	Pl	100	10000	1600
1009, 2081, 2084, 2085, 2093, 2097, 2552, 2561	Pl leading mixed-wood	15	5	2	Art	65	Sx	90	1400	
				2			Pl	10	1600	
				1	Nat	35	At	100	10000	
2064, 2061, 1056, 2076, 2073, 2521, 1556	S leading mixed-wood	15	5	2	Art	65	Sx	100	1400	
				1	Nat	35	At	100	10000	
1051, 1052, 1053, 1005	Aspen leading	15	5	1	Nat	90	At	90	10000	
				1			Ac	10	10000	
				2	Art	10	At	100	1400	
2101, 2102, 2103	Aspen leading mixed-wood	15	5	1	Nat	65	At	100	10000	
				2	Art	35	Sx	90	1400	
				2			Pl	10	1600	

Data source and comments:

Class A seed has not been collected so tree improvement has not be factored into the regenerated growth and yield curves.

Advanced regeneration is present in stands in the ESSF BEC zone.

Brushing activities are expected in the mixed-wood deciduous-leading analysis units to release the conifer component.

Operational adjustment factors (OAFs) were used to adjust timber yield estimates to account for operational factors. OAF1 is a constant percentage reduction to account for small stocking gaps within stands. OAF2 accounts for losses that increase with stand age, for example decay due to disease. In this case OAF2 increases from 0 at stand establishment and passes through 5% at 100 years of age. Provincial average operational adjustment factors (OAFs) values were applied to the managed stand yield curves, as recommended by the Ministry of Forests, Research Branch, as no local OAFs are available.

A.4.3.2 Immature plantation history

This section identifies areas of existing immature forest where the density (stems per hectare) has been controlled, therefore justifying growth projection based on managed stand yield tables (MSYTs).

Table A-20. shows the plantation history of the Fort St. John TSA. Prior to separating the analysis units into groups for productivity (good, medium and poor), the area considered to be managed was re-assigned, proportionately, to managed stand analysis units based on the total area in each species group in Table A-20.

Table A-20. Immature plantation history

Leading species of the analysis unit	Area managed (hectares)			
	Age 1-10	Age 11-20	Age 21-30	Age 31-40
Pine leading	1 370	2 120	1 035	6[a]
Spruce leading	12 333	18 654	0	0
Deciduous leading	0	0	0	0

(a) The 6 hectares in the age 31-40 is too small to re-assign to managed stand analysis units.

Assumptions:

1) All juvenile spaced stands in ISIS were leading pine;

2) Ninety per cent of brushing activity occurred on Sx-leading stands, with the remaining 10% occurring on Pli-leading stands;

3) Average age at time of spacing was 15 years;

4) Average age at time of brushing was 5 years.

Data source and comments:

Data was obtained from the Integrated Silviculture Information System (ISIS) and the Major Licensee Silviculture Information System (MLSIS). Growth for managed stands was projected using TIPSY, where information is available. The unmanaged portion was projected using VDYP.

Some plantations older than 10 years may not have received density control and are assumed to be unmanaged rather than managed growth profile, and are not included in Table A-20. While this assumption is conservative, district staff believe it is reasonable.

A.4.3.3 Not satisfactorily restocked (NSR) areas

Type identity classifications of 4 or 9 identify the land base that is not satisfactorily restocked (NSR). An NSR label is used to denote forest lands that are not growing to their full potential due to insufficient stocking of preferred and/or acceptable tree species.

There are total of 58 538 hectares of NSR area on the FIP file. Of that amount 734 hectares are in the cable/helicopter logging area and are assumed to remain in the assigned analysis units (existing/natural stands). The remaining 57 800 hectares are assumed to be managed stands.

As noted in Section A.3.18, "Non-productive burn areas", area labelled as NSR has not been re-classified as non-commercial or non-productive forest. After accounting for this and the cable/helicopter NSR land base, the remaining 57 800 hectares of forest classified as NSR was assigned to analysis units based on: (1) known information from silvicultural records; and (2) remaining area to be was assigned, proportionately, across all managed stand analysis units.

A.4 Forest Management Assumptions

Known information-silvicultural records

Table A-21. identifies the current and backlog area of NSR in the timber harvesting land base from the forest district silviculture records. All assignment of NSR land base was performed prior to separating the analysis units into groups for productivity (good, medium and poor) and maturity (young, thrifty and old).

Table A-21. Not satisfactorily restocked (NSR) areas-silvicultural records

	Backlog NSR		**Current NSR**	
Analysis unit	**Area (hectares)**	**Rate of restocking (years)**	**Area (hectares)**	**Rate of restocking (years)**
Entire TSA				
Logged			7 000	1-10
Burned	8 100	1-20		
Total	8 100		7 000	

- ISIS records show 7000 hectares of logged forest. This area will be re-established within the first decade (2000-2010).
- ISIS records show 8100 hectares of burned forest. This will be re-established within the first two decades (2000-2020). For the analysis the rate of re-establishment will be assumed to be 1/20 of the area (405 hectares per year) for the first 20 years.

The technical assignment of the NSR areas was performed in the following manner:

- Current NSR — 7000 hectares of pine-leading stands with default inventory group source code (D) and no fire disturbance history was re-assigned to be 40% conventional pine and 60% conventional spruce managed stand analysis units. As these areas have had density control, no area has been assigned to mixed-wood analysis units.
- Backlog NSR — 8100 hectares of pine-leading stands with default inventory group source code (D) and a fire disturbance history was re-assigned to be 36% conventional pine and 64% conventional spruce managed stand analysis units. The backlog area is assumed to be restocked over a 20 year period and in the analysis the area was split into 4 portions aged –3, –8, –13 and –20 years. As these areas have had density control, no area has been assigned to mixed-wood analysis units.

Remaining NSR area

The remaining 42 700 hectares of NSR were assigned to managed stand analysis units in the following manner:

- It was assumed the remaining area is distributed among managed analysis units following the profile of the existing forest;
- The existing forest was defined as those stands greater than sixty years of age;
- Of the 42 700 hectares of NSR, 5082 hectares were assigned leading species based on silvicultural history, adjacent stands or pre-harvest data. The remaining 37 618 hectares have the first species assigned by default (ITG 28 and ITG source code = D). Where possible, the latter was used if a change in the leading species was necessary to meet the profile of the existing forest.
- Analysis units were assigned managed stand analysis unit codes.

A.4.3.4 Rehabilitation areas

While there have been past rehabilitation operations, none are expected to occur within the TSA in the foreseeable future. Any future rehabilitation will be considered in future analysis.

A.4.4 Integrated resource management

A.4.4.1 Forest cover requirements

The timber supply model used (FSSIM Version 4.1) can incorporate forest cover requirements that specify both the maximum proportion of an area allowed in a disturbed condition, and the minimum required area of old-age forest. As noted in Section A.2.1, "Management zones", forest cover requirements were applied to model a number of objectives. Where a management group (e.g., retention VQO) spans more than one landscape unit, the forest cover requirements were modelled at the landscape unit level.

Fort St. John land and resource management plan (LRMP)

The Fort St. John LRMP was approved by cabinet in October 1997. The plan divides the TSA into 27 resource management zones (RMZs) based on resource values, economic activity, environmentally important areas and agricultural land reserve (ALR) boundaries. The RMZs fall within one of five broad categories: agricultural/settlement, enhanced resource development, general resource development, special management and major river corridors. Eleven new protected areas were approved and comprise approximately 4.25% of the plan area. Five of these have now been designated under the *Parks Act.*

The Fort St. John LRMP recommended that the Graham-Laurier protected area, Redfern-Keily protected area and Besa-Halfway-Chowade and Graham North RMZs be formally designated as the Muskwa-Kechika management area. The *Muskwa-Kechika Management Area Act* was put in place to implement the recommendation. Resource development within these areas will be consistent with both the *Act* and the LRMP. Forest development plans for the Graham North and Besa-Halfway-Chowade RMZs can only be approved after landscape unit objectives have been established.

At this time no specific management prescriptions has been approved for the Fort St. John LRMP management zones so they are only be incorporated into the analysis for reporting purposes.

Caribou habitat areas

Four areas are managed for critical caribou habitat. The forests of this area also contain critical habitat for a variety of fur bearers. Four sub-zones have been identified, each relating to a separate population of caribou inhabiting distinct areas within the TSA. Each sub-zone has a different management practice that has been developed and implemented to sustain caribou and other species that require similar habitats.

Table A-22. Caribou habitat area forest cover requirement

Areas	Forest cover requirement	Species under consideration
Graham	The gross productive forest area is managed to maintain a minimum of 40% in mature age classes (greater than 140 years).	Caribou and other fur bearers
Kobes Creek	The gross productive forest area is managed to maintain a minimum of 40% in mature age classes (greater than age 120 years).	Caribou and other fur bearers
Hackney Hills	The gross productive forest area is managed to maintain a minimum of 40% in mature age classes (greater than 100 years).	Caribou and other fur bearers
Milligan Hills	The timber harvesting land base is managed on a 2-pass system with 40-year green-up between passes.	Caribou and other fur bearers

Visual quality objectives (VQO) and integrated resource management (IRM)

The VQO for each area in the Fort St. John TSA was determined by VQO mapping as shown in the FIP file. Guidelines provided in the *Procedures for Factoring Visual Resources into Timber Supply Analyses* were used to derive forest cover requirements for area under each VQO within each landscape unit. Areas with an assigned VQO or within the Milligan Hills caribou management area were also subject to adjacency forest cover requirements. Table A-23. shows the per cent of the total forested area or timber harvesting land base that is allowed to be not visually greened-up at any time. Some areas not available for harvesting, for example riparian reserves and inoperable area, contribute towards visual quality objectives. VQO and adjacency requirements were modelled at the landscape unit level.

The visual absorption capability (VAC) ratings from the FIP file were not employed in developing forest cover requirements for VQO areas. The VACs are not applicable to current practices in the TSA. Current practice in the VQO areas is generally to design harvests such that the mid-point of recommended disturbance range is employed. The base case in the analysis reflected this practice.

Table A-23. VQO and IRM forest cover requirements

Zone or group	Green–up maximum allowable disturbance (%)	Green–up height[a] (metres)	Minimum older area (years)	Minimum area of older age retained (%)	Land base constraints applied to
VQO — preservation	1	5	N/A	N/A	Crown forested area
VQO — retention	3	5	N/A	N/A	Crown forested area
VQO — partial retention	10	5	N/A	N/A	Crown forested area
VQO — modification	20.5	5	N/A	N/A	Crown forested area
VQO — maximum modification	33	5	N/A	N/A	Crown forested area
IRM or non-VQO	40	3	N/A	N/A	Timber harvesting land base

Green-up was modelled as the age to which green-up height is estimated to be achieved. The Site Tools model was used to estimate green-up age for each stand. These are provincial estimates and were adjusted to align with the estimates for the Prince George Region (August 2000, *Age to Green-up Height: Using Regeneration Survey Data by Region Species and Site Index*). The average area-weighted age by VQO and landscape unit was calculated and used in the timber supply analysis.

Landscape-level biodiversity forest cover requirements

Only old-seral guidelines were modelled in the base case, consistent with the assumption used in the February 1996, *1996 Forest Practices Code Timber Supply Analysis*. While landscape units and biodiversity emphasis option (BEO) are draft, they were modelled in the base case. Table A-24. lists the draft landscape units and biodiversity emphasis options.

A.4 Forest Management Assumptions

Table A-24. Draft landscape unit and biodiversity emphasis options

Landscape unit number	Landscape unit name	Biodiversity emphasis option
1	Lower Beatton/Alces River	Low
2	Doig River	Intermediate
3	Osborne River	Intermediate
4	Milligan Creek	Intermediate
5	Big Arrow Creek	Intermediate
6	Cautley Creek/Kahntah River	Intermediate
7	Chinchaga River	Intermediate
8	Ettithun River	Intermediate
9	Upper Fontas River	Intermediate
10	Niteal Creek/Lower Kahntah River	Intermediate
11	Sikanni River/ Fontas River	High
12	Katah Creek/Gutah Creek	Low
13	Conroy Creek	Low
14	Black Creek/Nig Creek	Low
15	Umbach Creek	Low
16	Aitken Creek/Blueberry River	Low
17	Colt Creek	Low[a]
18	Cache Creek	Low
19	Farrell Creek	Intermediate
20	Lower Cameron River	Low
21	Kobes Creek/Groundbirch Creek	Low
22	Upper Cameron River	Low
23	Jedney Creek/Beatton River	Low
24	Grewatsch Creek/Holman Creek	Low
25	Donnie Creek/Temple Creek	Intermediate
26	Boat Creek/Dehacho Creek	Intermediate
27	Trutch Creek/Horse Range Creek	Intermediate
28	Middlefork Creek/Medana creek	Intermediate
29	Buckinghorse River	High
30	Middle Sikanni	Intermediate
31	Trimble Creek/Loranger Creek	High
32	Lower Cypress/Halfway River	High
33	Upper Cypress Creek	High
34	Upper Chowade River	High
35	Horseshoe/Bluegrave	Intermediate
36	Graham South	Intermediate
37	Graham North	High
38	Graham-Laurier	High
39	Upper Halfway River	High
40	Upper Sikanni River	High
41	Keily Creek	High
43	Lilly Lake	High[a]

(a) Currently no emphasis option has been assigned. For the analysis forest district staff made their best estimation of the emphasis option for the landscape unit.

A.4 Forest Management Assumptions

The landscape-level biodiversity requirements were modelled at the biogeoclimatic unit and natural disturbance type (NDT) level. For low BEO the forest cover requirements are phased–in; i.e., one-third of the value for the first rotation (0-70 years), two-thirds for the second rotation and the full value for the remainder of the planning horizon (141 plus years).

A sensitivity analysis was performed using a 45/45/10 distribution of low, intermediate and high biodiversity emphasis. Table A-25. presents the old-seral stage requirements by biogeoclimatic unit and natural disturbance type (NDT) based on the *Landscape Unit Planning Guide.*

Table A-25. Landscape unit biodiversity requirements within the Fort St. John TSA

			Old-seral stage			
			Minimum retention area (%)			
Biogeoclimatic unit	**NDT**	**Biodiversity emphasis**	**Now**	**71 years**	**141 years**	**Minimum age (years)**
ESSF	1	Low	19	19	19	250
		Intermediate	19	19	19	250
		High	28	28	28	250
		45/45/10 L/I/H	14.2	17.1	19.9	250
ESSF	2	Low	9	9	9	250
		Intermediate	9	9	9	250
		High	13	13	13	250
		45/45/10 L/I/H	6.7	8.1	9.4	250
SWB	2	Low	9	9	9	250
		Intermediate	9	9	9	250
		High	13	13	13	250
		45/45/10 L/I/H	6.7	8.1	9.4	250
BWBS–c[a]	3	Low	11	11	11	140
		Intermediate	11	11	11	140
		High	16	16	16	140
		45/45/10 L/I/H	8.2	9.9	11.5	140
BWBS–d[b]	3	Low	9.7	11.7	13.6	100
		Intermediate	13	13	13	100
		High	19	19	19	100
		45/45/10L/I/H	9.7	11.7	13.6	100

(a) BWBS with coniferous species prominent.

(b) BWBS with deciduous species prominent.

A.4.4.2 Wildlife tree patches (WTPs)

Wildlife tree patches (WTPs) are the primary method used to maintain mature stand structure elements over time. Plans are to maintain WTPs for one rotation. If harvested before that time WTPs of comparable size and structure will be identified as replacements.

As part of landscape unit planning an assessment of the area recommended for WTP retention was performed. The assessment was based upon Table A3.1 of the *Landscape Unit Planning Guide* where the area required for WTP retention is based on the amount of area that has been harvested without WTP retention and the amount of area available for harvest. The results of the assessment are presented in Table A-26., "Recommended WTP reductions by landscape unit, BEC zone and coniferous/deciduous content." These reductions were modelled in the base case.

An area reduction was used to model wildlife tree patch requirements because as it more accurately reflects current management and thus the area upon which harvesting will occur. These wildlife tree patches, in conjunction with other riparian reserves and area removals, are generally larger than two hectares in size and are left to maintain stand structure within the landscape over time. As the wildlife tree patches are larger than two hectares in size, this area will contribute to meeting seral-stage forest requirements at the landscape level. It is assumed that wildlife tree patches will not be economical to harvest at a later date, and will be retained as WTPs during subsequent harvests of the stand.

While preservation, retention and partial retention VQO zones are expected to have sufficient stand structure present to meet WTP requirements, the WTP reduction was modelled across the entire timber harvesting land base. The WTPs contribute to achievement of the VQO.

A.4 Forest Management Assumptions

Table A-26. Recommended WTP reductions by landscape unit, BEC zone and coniferous/deciduous content

Landscape unit number	Landscape unit name	Target WTP (%) BEC zone BWBS dec / con[a]	Target WTP (%) BEC zone ESSF dec / con[a]	Target WTP (%) BEC zone SWB dec / con[a]
1	Lower Beatton/Alces River	4 / 4	—	—
2	Doig River	6 / 4	—	—
3	Osborne River	6 / 5	—	—
4	Milligan Creek	6 / 6	—	—
5	Big Arrow Creek	5 / 7	—	—
6	Cautley Creek/Kahntah River	6 / 6	—	—
7	Chinchaga River	6 / 4	—	—
8	Ettithun River	6 / 7	—	—
9	Upper Fontas River	5 / 7	—	—
10	Niteal Creek/Lower Kahntah River	4 / 6	—	—
11	Sikanni River/ Fontas River	5 / 4	—	—
12	Katah Creek/Gutah Creek	4 / 6	—	—
13	Conroy Creek	4 / 5	—	—
14	Black Creek/Nig Creek	6 / 5	—	—
15	Umbach Creek	5 / 5	—	—
16	Aitken Creek/Blueberry River	7 / 5	—	—
17	Colt Creek	6 / 6	7 / 6	—
18	Cache Creek	5 / 5	—	—
19	Farrell Creek	4 / 4	—	—
20	Lower Cameron River	3 / 3	—	—
21	Kobes Creek/Groundbirch Creek	3 / 3	2 / 3	—
22	Upper Cameron River	2 / 1	—	—
23	Jedney Creek/Beatton River	2 / 2	—	1 / 2
24	Grewatsch Creek/Holman Creek	3 / 3	—	—
25	Donnie Creek/Temple Creek	1 / 1	—	—
26	Boat Creek/Dehacho Creek	1 / 2	—	—
27	Trutch Creek/Horse Range Creek	1 / 1	—	—
28	Middlefork Creek/Medana creek	1 / 1	—	—
29	Buckinghorse River	1 / 1	—	0 / 1
30	Middle Sikanni	1 / 1	—	0 / 0
31	Trimble Creek/Loranger Creek	1 / 2	—	1 / 2
32	Lower Cypress/Halfway River	4 / 6	0 / 3	0 / 1
33	Upper Cypress Creek	3 / 2	2 / 2	6 / 2
34	Upper Chowade River	3 / 5	1 / 3	—
35	Horseshoe/Bluegrave	5 / 4	5 / 5	—
36	Graham South	1 / 4	3 / 4	—
37	Graham North	3 / 4	4 / 4	—
38	Graham-Laurier	1 / 4	5 / 2	—
39	Upper Halfway River	0 / 3	0 / 6	0 / 2
40	Upper Sikanni River	—	—	4 / 3
41	Keily Creek	0 / 3	—	0 / 0
43	Lilly Lake	0 / 3	—	4 / 2

(a) dec = deciduous content and con = coniferous content.

A.5 Volume Estimates for Existing Stands

The variable density yield projection (VDYP) model, version 6.5a developed and supported by the Ministry of Sustainable Resource Management, Terrestrial Information Branch, was used to estimate timber volumes for existing natural stands. Table A-27. shows the volume estimates by analysis unit for existing natural stands.

Table A-27. Timber volume tables for existing natural stands (cubic metres per hectare)

	Existing stand analysis units (see Table A-16. for description)							
Age (years)	**11**	**12**	**13**	**14**	**15**	**16**	**21**	**24**
10	0	0	0	0	0	0	0	0
20	0	0	0	0	0	0	0	0
30	0	0	0	0	0	0	2	29.2
40	7.1	0	0	9.0	0.1	0	25.9	86.6
50	32.7	0	0	50.5	0.7	0	62.8	138.0
60	85.9	12.2	0	108.7	22.7	0	98.6	183.4
70	135.4	47.3	0.1	160.2	58.6	0	131.5	223.7
80	178.8	85.7	4.2	204.8	97.6	14.4	161.6	259.5
90	216.3	120.6	12.9	243.0	132.9	45.2	189.4	292.2
100	248.5	151.9	25.2	275.4	164.5	74.2	215.2	322.2
110	276.2	180.0	39.5	303.0	192.7	101.1	239.3	349.9
120	300.0	205.0	53.3	326.4	217.8	126.0	261.9	375.6
130	321.6	228.1	69.2	347.6	240.8	149.5	283.1	399.6
140	340.5	248.8	88.8	366.2	261.4	171.2	297.5	415.1
150	357.2	267.4	107.5	382.4	279.8	191.2	308.8	427.0
160	371.4	283.8	125.2	396.1	296.1	209.6	316.9	435.1
170	384.0	298.6	141.9	408.2	310.6	226.6	321.9	439.5
180	395.1	311.9	157.7	418.8	323.6	242.1	323.8	440.4
190	404.9	323.8	172.7	428.1	335.4	256.5	322.6	437.6
200	413.6	334.7	187.0	436.4	346.0	269.8	325.0	439.6
210	421.4	344.5	200.6	443.8	355.7	282.0	327.7	442.0
220	428.4	353.5	213.3	450.3	364.4	293.2	330.5	444.7
230	434.6	361.6	225.4	456.0	372.4	303.7	333.1	447.5
240	440.1	369.0	236.8	461.2	379.6	313.3	335.7	450.2
250	445.0	375.7	247.5	465.7	386.2	322.2	338.1	452.8
260	449.3	381.9	257.6	469.6	392.1	330.3	340.4	455.3
270	453.2	387.5	267.0	473.0	397.5	338.0	342.4	457.7
280	456.7	392.6	276.0	476.0	402.4	345.0	344.3	459.9
290	459.7	397.2	284.4	478.5	406.8	351.5	346.1	462.0
300	462.2	401.4	292.4	480.7	410.8	357.6	347.6	463.9
310	464.4	405.2	299.9	482.6	414.4	363.2	349.0	465.7
320	466.4	408.5	307.0	484.2	417.6	368.4	350.2	467.4
330	468.1	411.4	313.8	485.6	420.4	373.3	351.2	468.8
340	469.5	414.0	320.2	486.8	422.9	377.8	352.0	470.1
350	470.8	416.3	326.2	487.8	425.1	381.9	352.7	471.3

(continued)

A.5 Volume Estimates for Existing Stands

Table A-27. Timber volume tables for existing natural stands (cubic metres per hectare)

Age (years)	Existing stand analysis units (see Table A-16. for description)							
	25	26	28	29	31	34	35	51
10	0	0	0	0	0	0	0	0
20	0	0	0	0	0	0	0	0
30	3.3	0	2.2	0	0	0	0	19.2
40	45.6	22.4	39.9	0	0	3.3	0	63.6
50	89.3	61.1	82.3	9.2	0.4	35.5	12.3	108.3
60	128.9	96.8	120.6	36.7	20.7	66.0	38.7	151.5
70	164.7	129.5	155.4	62.6	43.5	94.2	63.9	192.5
80	197.1	159.5	186.9	87.2	65.1	120.4	87.4	223.9
90	226.9	187.3	215.9	110.6	85.6	144.9	109.7	250.9
100	254.5	213.1	242.9	132.8	105.1	167.9	130.7	272.6
110	280.0	237.1	268.0	153.9	123.7	189.5	150.6	288.8
120	303.9	259.7	291.4	174.0	141.3	209.8	169.5	299.6
130	326.4	281.0	313.6	193.3	158.2	229.3	187.5	305.0
140	341.2	295.5	328.4	206.8	170.5	242.5	200.2	312.9
150	352.7	306.8	339.8	217.8	180.5	253.1	210.5	320.1
160	360.7	314.9	348.0	225.9	188.2	260.9	218.2	320.2
170	365.4	320.0	352.9	231.4	193.7	265.8	223.4	320.3
180	366.7	321.9	354.5	234.1	196.8	268.1	226.1	320.4
190	364.8	320.8	352.8	234.2	197.7	267.5	226.4	320.5
200	366.9	323.3	355.1	237.0	200.7	270.0	229.1	320.5
210	369.5	326.0	357.8	239.9	203.7	272.6	232.0	320.6
220	372.1	328.8	360.5	242.8	206.6	275.4	234.8	320.6
230	374.7	331.5	363.2	245.6	209.4	278.0	237.5	320.7
240	377.3	334.1	365.9	248.2	211.9	280.5	240.0	320.7
250	379.7	336.5	368.4	250.7	214.4	282.8	242.3	320.8
260	382.0	338.8	370.7	252.9	216.6	284.9	244.5	320.8
270	384.2	340.9	372.9	254.9	218.5	286.9	246.4	320.8
280	386.1	342.8	374.9	256.8	220.3	288.6	248.2	320.9
290	387.9	344.6	376.7	258.3	221.9	290.3	249.7	320.9
300	389.6	346.1	378.4	259.7	223.2	291.7	251.1	320.9
310	391.1	347.5	379.9	260.9	224.5	292.9	252.3	320.9
320	392.4	348.7	381.2	261.9	225.5	294.0	253.3	320.9
330	393.5	349.7	382.4	262.8	226.4	294.9	254.2	321.0
340	394.5	350.6	383.4	263.4	227.0	295.6	254.9	321.0
350	395.3	351.3	384.2	263.9	227.5	296.2	255.4	321.0

(continued)

A.5 Volume Estimates for Existing Stands

Table A-27. Timber volume tables for existing natural stands (cubic metres per hectare)

Age (years)	Existing stand analysis units (see Table A-16. for description)							
	52	53	61	62	64	65	66	71
10	0	0	0	0	0	0	0	0
20	0	0	0	0	0	0	0	0
30	1.2	0	0	0	0	0	0	0
40	25.5	3.3	1.2	0	9	0	0	1.3
50	58.6	25.8	12.2	0	53.6	10.7	0.1	10.8
60	91.2	50.7	50.9	8.1	111.2	52.1	9.6	50.7
70	122.8	75.2	96.7	31.8	165.4	98.4	39.0	99.1
80	147.7	95.2	139.3	62.0	213.5	141.3	74.0	142.6
90	169.2	112.5	177.0	91.9	255.2	179.4	106.7	181.4
100	186.5	126.7	209.7	120.2	289.7	212.7	136.7	216.1
110	199.7	137.6	237.8	146.4	317.6	241.1	163.8	246.9
120	208.7	145.3	261.8	170.4	340.7	265.3	188.2	274.3
130	213.5	149.7	283.0	192.8	360.2	286.5	210.5	299.1
140	219.7	154.7	301.5	211.9	377.3	305.0	229.6	319.8
150	225.2	159.1	317.9	229.3	392.3	321.4	246.7	337.5
160	225.5	159.4	328.3	240.8	401.2	331.7	258.1	351.2
170	225.7	159.6	337.4	251.1	408.9	340.7	268.2	362.9
180	225.8	159.7	345.4	260.3	415.5	348.5	277.2	372.7
190	225.9	159.9	352.4	268.5	421.2	355.4	285.2	380.9
200	226.1	160.0	358.7	276.1	426.4	361.7	292.5	389.0
210	226.2	160.1	364.4	283.0	431.0	367.3	299.2	396.2
220	226.3	160.3	369.5	289.3	435.0	372.3	305.3	402.9
230	226.4	160.4	374.1	295.1	438.6	376.9	310.8	408.9
240	226.5	160.5	378.3	300.4	441.7	380.9	315.8	414.3
250	226.6	160.6	382.0	305.2	444.5	384.6	320.4	419.1
260	226.7	160.6	385.3	309.6	446.9	387.9	324.6	423.5
270	226.7	160.7	388.3	313.6	449.1	390.9	328.4	427.4
280	226.8	160.8	391.0	317.3	450.9	393.5	331.8	431.0
290	226.8	160.8	393.4	320.7	452.5	395.9	335.0	434.2
300	226.9	160.9	395.6	323.8	453.8	398.0	337.9	437.0
310	226.9	160.9	397.5	326.6	454.9	399.9	340.5	439.5
320	227.0	161.0	399.1	329.2	455.9	401.5	342.9	441.7
330	227.0	161.0	400.6	331.5	456.7	402.9	345.0	443.8
340	227.0	161.1	401.8	333.6	457.4	404.1	347.0	445.5
350	227.1	161.1	402.9	335.5	458.0	405.1	348.7	447.1

(continued)

A.5 Volume Estimates for Existing Stands

Table A-27. Timber volume tables for existing natural stands (cubic metres per hectare)

	Existing stand analysis units (see Table A-16. for description)							
Age (years)	**72**	**73**	**74**	**75**	**76**	**81**	**84**	**85**
10	0	0	0	0	0	0	0	0
20	0	0	0	0	0	0	0	0
30	0	0	0	0	0	1.3	28.0	5.9
40	0	0	12.2	0.1	0	19.3	81.7	38.6
50	0.1	0	65.4	10.6	0.1	50.2	131.8	79.9
60	6.6	0.1	126.6	54.2	6.2	83.1	176.3	117.4
70	34.0	0.4	180.9	102.7	31.4	113.5	215.9	151.4
80	71.6	5.3	228.5	146.7	66.3	140.1	249.5	180.7
90	107.4	17.6	269.6	186.0	101.6	164.1	279.7	207.1
100	140.5	35.8	304.6	221.1	134.5	185.5	306.4	230.5
110	171.1	55.4	334.6	252.3	165.0	204.7	329.9	251.2
120	199.3	74.6	360.5	279.9	193.2	221.8	350.5	269.5
130	225.6	95.3	382.8	304.8	219.6	237.0	368.5	285.4
140	248.3	116.5	400.3	325.2	242.5	247.9	381.0	296.6
150	268.2	136.2	415.2	342.7	262.8	256.6	390.7	305.5
160	284.8	154.3	426.6	356.4	279.9	261.9	396.2	310.5
170	299.1	171.0	436.2	368.1	294.9	265.3	399.2	313.4
180	311.5	186.2	444.1	378.0	308.0	266.8	399.6	314.3
190	322.1	200.1	450.6	386.2	319.3	266.3	397.5	313.0
200	332.5	213.5	456.9	394.3	330.1	268.1	398.8	314.4
210	342.0	226.1	462.5	401.6	340.2	270.0	400.5	316.0
220	350.8	238.1	467.5	408.3	349.4	271.9	402.3	317.7
230	358.8	249.3	471.9	414.3	357.9	273.7	404.3	319.4
240	366.2	260.0	475.9	419.7	365.7	275.5	406.2	321.1
250	373.0	270.0	479.4	424.5	372.9	277.1	408.0	322.7
260	379.1	278.7	482.4	428.9	379.4	278.7	409.8	324.2
270	384.8	286.9	485.1	432.8	385.4	280.1	411.5	325.6
280	389.9	294.6	487.4	436.3	390.9	281.4	413.1	326.9
290	394.6	301.8	489.4	439.4	395.9	282.6	414.6	328.1
300	398.9	308.6	491.2	442.1	400.4	283.7	416.0	329.2
310	402.8	315.0	492.8	444.6	404.6	284.7	417.3	330.2
320	406.3	321.0	494.1	446.8	408.4	285.6	418.5	331.2
330	409.5	326.6	495.3	448.8	411.8	286.3	419.6	332.0
340	412.3	331.8	496.3	450.5	414.9	287.0	420.6	332.7
350	414.9	336.5	497.2	452.0	417.6	287.5	421.5	333.3

(continued)

A.5 Volume Estimates for Existing Stands

Table A-27. Timber volume tables for existing natural stands (cubic metres per hectare)

Age (years)	Existing stand analysis units (see Table A-16. for description)							
	86	91	93	94	95	96	97	101
10	0	0	0	0	0	0	0	0
20	0	0	0	0	0	0	0	0
30	0	3.6	0	15.0	0.1	0	3.5	5.8
40	15.3	37.0	0.7	69.3	28.0	0.8	34.6	49.7
50	45.7	79.9	11.5	119.0	68.6	18.4	75.1	98.4
60	78.1	118.5	35.3	162.2	105.6	45.7	112.7	143.3
70	108.0	152.7	60.6	200.0	138.6	71.2	146.2	184.4
80	134.1	182.9	83.7	233.0	168.0	94.4	175.7	217.3
90	157.8	209.9	105.1	262.3	194.6	115.7	202.2	245.3
100	179.0	234.2	124.7	288.5	218.7	135.1	226.0	268.3
110	197.9	256.1	143.0	312.1	240.6	153.2	247.5	286.5
120	214.6	276.0	159.9	333.5	260.7	169.9	267.0	300.1
130	229.4	294.4	175.8	353.2	279.3	185.5	284.8	309.6
140	239.9	307.5	187.7	366.9	292.4	197.1	297.2	319.3
150	248.2	318.0	197.6	377.6	302.9	206.6	307.2	328.0
160	253.0	325.5	205.4	385.3	310.5	214.1	314.1	331.4
170	256.0	330.6	211.3	390.3	315.7	219.7	318.7	334.4
180	257.0	333.3	215.2	392.6	318.5	223.4	321.1	336.8
190	256.2	333.7	217.2	392.3	318.8	225.2	321.2	338.9
200	257.6	336.5	220.8	395.0	321.7	228.5	323.7	340.8
210	259.2	339.4	224.3	397.8	324.6	231.9	326.3	342.4
220	260.9	342.3	227.7	400.7	327.5	235.0	328.9	343.9
230	262.4	345.0	230.8	403.4	330.3	238.0	331.4	345.2
240	264.0	347.6	233.7	406.0	332.9	240.8	333.8	346.3
250	265.4	350.1	236.4	408.5	335.4	243.3	336.1	347.3
260	266.8	352.3	238.9	410.8	337.6	245.7	338.1	348.2
270	268.1	354.4	241.2	412.9	339.7	247.9	340.0	349.0
280	269.3	356.3	243.2	414.9	341.7	249.9	341.8	349.7
290	270.3	358.1	245.1	416.7	343.4	251.6	343.3	350.2
300	271.3	359.7	246.8	418.3	345.0	253.3	344.8	350.8
310	272.1	361.1	248.4	419.8	346.4	254.7	346.1	351.2
320	272.9	362.4	249.7	421.2	347.7	256.1	347.2	351.6
330	273.6	363.5	250.9	422.4	348.8	257.2	348.2	351.9
340	274.2	364.5	252.0	423.4	349.7	258.2	349.1	352.1
350	274.6	365.3	252.8	424.4	350.6	259.0	349.9	352.3

(continued)

A.5 Volume Estimates for Existing Stands

Table A-27. Timber volume tables for existing natural stands (cubic metres per hectare)

	Existing stand analysis units (see Table A-16. for description)							
Age (years)	**102**	**103**	**111**	**112**	**113**	**121**	**122**	**123**
10	0	0	0	0	0	0	0	0
20	0	0	0	0	0	0	0	0
30	0.1	0	16.1	1.4	0	10.2	0.2	0
40	16.1	0.8	62.5	26.9	3.6	55.5	20.4	1.4
50	54.9	18.7	107.3	63.0	26.0	99.1	56.8	24.7
60	91.8	46.5	149.0	97.4	51.7	139.1	89.9	52.8
70	126.3	73.0	187.5	129.8	76.3	175.5	120.4	79.1
80	154.8	95.5	218.9	156.7	97.4	204.2	145.0	101.2
90	179.3	115.2	246.5	180.4	116.2	228.7	166.2	120.4
100	199.7	132.0	269.9	200.6	132.4	248.9	183.7	136.8
110	216.2	145.9	289.2	217.4	146.2	264.8	197.7	150.3
120	228.8	157.0	304.5	230.8	157.5	276.6	208.3	161.1
130	238.0	165.5	315.8	241.0	166.5	283.9	215.4	169.2
140	247.2	173.6	325.6	249.8	173.8	291.6	222.7	176.9
150	255.3	180.6	333.9	257.1	179.9	298.6	229.3	183.9
160	259.0	184.3	336.6	259.9	182.5	299.4	230.1	185.2
170	262.2	187.5	338.3	261.6	184.3	300.2	230.8	186.3
180	264.9	190.4	338.7	262.4	185.2	300.8	231.5	187.3
190	267.3	192.8	338.0	262.3	185.4	301.2	232.0	188.1
200	269.5	195.1	338.8	263.2	186.3	301.7	232.4	188.9
210	271.4	197.1	339.7	264.2	187.3	302.1	232.9	189.6
220	273.2	199.0	340.7	265.2	188.3	302.5	233.2	190.3
230	274.7	200.7	341.6	266.2	189.3	302.8	233.6	190.9
240	276.1	202.2	342.5	267.1	190.1	303.1	233.9	191.5
250	277.4	203.6	343.5	268.0	191.0	303.4	234.2	192.0
260	278.5	204.8	344.3	268.8	191.7	303.6	234.4	192.5
270	279.5	206.0	345.1	269.6	192.4	303.8	234.7	192.9
280	280.4	207.0	345.9	270.2	193.1	304.0	234.9	193.3
290	281.2	207.9	346.6	270.9	193.7	304.1	235.0	193.6
300	281.9	208.7	347.2	271.5	194.2	304.2	235.2	194.0
310	282.5	209.5	347.8	272.0	194.6	304.3	235.3	194.3
320	283.1	210.2	348.4	272.4	195.1	304.4	235.5	194.5
330	283.6	210.8	348.9	272.9	195.4	304.5	235.6	194.8
340	284.0	211.3	349.3	273.2	195.7	304.6	235.7	195.0
350	284.4	211.8	349.7	273.5	196.0	304.6	235.8	195.2

(continued)

A.5 Volume Estimates for Existing Stands

Table A-27. Timber volume tables for existing natural stands (cubic metres per hectare) (concluded)

Age (years)	Existing stand analysis units (see Table A-16. for description) 511	514	521	561
10	0	0	0	0
20	0	0	0	0
30	0	0	6.7	0
40	1.4	5.9	49.8	2.4
50	9.6	39.7	94.7	19.5
60	29.5	94.6	134.8	60.7
70	55.7	144.5	170.5	106.0
80	85.2	188.2	202.3	148.8
90	114.7	225.7	231.0	187.5
100	142.4	257.8	257.1	221.4
110	169.7	285.3	280.9	251.1
120	194.1	308.8	302.8	277.1
130	216.8	330.2	323.3	300.4
140	237.4	348.9	337.3	320.1
150	256.0	365.2	348.3	337.3
160	272.8	379.3	356.1	349.9
170	288.0	391.7	361.1	360.9
180	301.9	402.6	363.2	370.2
190	314.5	412.2	362.5	378.2
200	326.0	420.8	365.0	385.8
210	336.6	428.5	367.8	392.7
220	346.2	435.2	370.7	398.9
230	355.0	441.3	373.4	404.5
240	363.1	446.7	376.1	409.6
250	370.5	451.4	378.5	414.2
260	377.3	455.6	380.9	418.2
270	383.5	459.3	383.0	421.9
280	389.1	462.6	385.0	425.2
290	394.3	465.3	386.8	428.1
300	399.1	467.7	388.4	430.8
310	403.4	469.8	389.9	433.1
320	407.3	471.6	391.2	435.1
330	410.8	473.1	392.4	437.0
340	414.1	474.5	393.4	438.6
350	417.0	475.6	394.3	440.0

A.6 Volume Estimates for Regenerated Stands

The batch version of TIPSY (Table Interpolation Program for Stand Yields) — a component of SiteTools 3.2 — supported by the B.C. Ministry of Forests, Research Branch, was used to estimate growth and yield for existing and future managed stands. The area-weighted site index listed for each analysis unit in Table A-17., "Minimum harvestable ages for the future, managed timber harvesting land base", and regeneration regimes summarized in Table A-19., "Regeneration assumptions by analysis unit", were used as inputs. Section A.4.3.2, "Immature plantation history" documents which stands are assumed to be managed in the analysis.

Table A-28. displays the volume tables for managed stands.

Table A-28. Timber volume tables for managed stands (cubic metres per hectare)

	Managed stand analysis units (see Table A-17. for description)							
Age (years)	**1001**	**1002**	**1005**	**1006**	**1007**	**1008**	**1009**	**1051**
10	0	0	0	0	0	0	0	0
20	0	0	0	0	0	0	0	0
30	0	2.0	0	0	0	0	0	19.2
40	2.0	27.9	3.3	4.6	3.2	9.2	9.2	63.6
50	22.0	66.8	25.8	37.9	34.3	47.9	47.9	108.3
60	73.0	110.6	50.7	90.1	82.4	101.6	101.6	151.5
70	135.0	149.5	75.2	145.4	137.5	154.5	154.5	192.5
80	190.0	183.2	95.2	191.0	182.4	200.3	200.3	223.9
90	241.0	211.2	112.5	236.3	226.3	244.5	244.5	250.9
100	290.0	234.2	126.7	275.3	267.8	280.9	280.9	272.6
110	334.0	255.0	137.6	306.0	299.0	309.7	309.7	288.8
120	371.0	273.6	145.3	326.2	318.6	328.1	328.1	299.6
130	393.0	289.7	149.7	342.1	335.7	343.3	343.3	305.0
140	413.0	303.4	154.7	355.0	348.6	354.9	354.9	312.9
150	428.0	312.7	159.1	365.1	359.9	365.0	365.0	320.1
160	441.0	317.9	159.4	372.9	368.4	372.2	372.2	320.2
170	451.0	325.6	159.6	380.0	374.2	378.7	378.7	320.3
180	461.0	329.8	159.7	384.6	379.4	381.3	381.3	320.4
190	468.0	334.9	159.9	387.8	382.7	384.5	384.5	320.5
200	474.0	340.7	160.0	389.8	386.6	383.9	383.9	320.5
210	478.0	342.9	160.1	388.5	385.3	383.9	383.9	320.6
220	482.0	344.9	160.3	387.2	384.0	382.6	382.6	320.6
230	482.0	346.9	160.4	386.5	383.3	383.2	383.2	320.7
240	479.0	346.8	160.5	383.9	382.7	380.6	380.6	320.7
250	478.0	346.9	160.6	382.6	379.4	380.0	380.0	320.8
260	475.0	347.9	160.6	382.6	378.1	378.0	378.0	320.8
270	475.0	347.9	160.7	380.0	378.1	376.7	376.7	320.8
280	471.0	346.2	160.8	378.7	377.5	375.4	375.4	320.9
290	470.0	348.0	160.8	378.1	375.5	374.1	374.1	320.9
300	470.0	348.0	160.9	378.1	375.5	374.1	374.1	320.9
310	470.0	348.0	160.9	378.1	375.5	374.1	374.1	320.9
320	470.0	348.0	161.0	378.1	375.5	374.1	374.1	320.9
330	470.0	348.0	161.0	378.1	375.5	374.1	374.1	321.0
340	470.0	348.0	161.1	378.1	375.5	374.1	374.1	321.0
350	470.0	348.0	161.1	378.1	375.5	374.1	374.1	321.0

(continued)

A.6 Volume Estimates for Regenerated Stands

Table A-28. Timber volume tables for managed stands (cubic metres per hectare)

	Managed stand analysis units (see Table A-17. for description)							
Age (years)	**1052**	**1053**	**1056**	**1551**	**1552**	**1556**	**2011**	**2012**
10	0	0	0	0	0	0	0	0
20	0	0	0	0	0	0	0	0
30	1.2	0	0	0	0	0	1	0
40	25.5	3.3	3.2	2.0	0	3.2	12.0	0
50	58.6	25.8	34.3	22.0	1.8	34.3	63.0	4.0
60	91.2	50.7	82.4	73.0	17.9	82.4	137.0	24.0
70	122.8	75.2	137.5	135.0	46.4	137.5	204.0	68.0
80	147.7	95.2	182.4	190.0	81.1	182.4	264.0	117.0
90	169.2	112.5	226.3	241.0	116.9	226.3	328.0	166.0
100	186.5	126.7	267.8	290.0	147.5	267.8	372.0	208.0
110	199.7	137.6	299.0	334.0	175.2	299.0	404.0	247.0
120	208.7	145.3	318.6	371.0	201.5	318.6	429.0	288.0
130	213.5	149.7	335.7	393.0	227.6	335.7	448.0	325.0
140	219.7	154.7	348.6	413.0	249.1	348.6	464.0	353.0
150	225.2	159.1	359.9	428.0	267.2	359.9	476.0	373.0
160	225.5	159.4	368.4	441.0	279.5	368.4	484.0	392.0
170	225.7	159.6	374.2	451.0	289.9	374.2	493.0	404.0
180	225.8	159.7	379.4	461.0	298.4	379.4	497.0	417.0
190	225.9	159.9	382.7	468.0	303.6	382.7	496.0	427.0
200	226.1	160.0	386.6	474.0	309.4	386.6	495.0	434.0
210	226.2	160.1	385.3	478.0	314.0	385.3	494.0	441.0
220	226.3	160.3	384.0	482.0	318.5	384.0	495.0	447.0
230	226.4	160.4	383.3	482.0	322.4	383.3	492.0	452.0
240	226.5	160.5	382.7	479.0	326.3	382.7	491.0	454.0
250	226.6	160.6	379.4	478.0	328.3	379.4	490.0	459.0
260	226.7	160.6	378.1	475.0	330.2	378.1	489.0	462.0
270	226.7	160.7	378.1	475.0	331.5	378.1	486.0	464.0
280	226.8	160.8	377.5	471.0	334.1	377.5	483.0	462.0
290	226.8	160.8	375.5	470.0	334.1	375.5	479.0	461.0
300	226.9	160.9	375.5	470.0	334.1	375.5	479.0	461.0
310	226.9	160.9	375.5	470.0	334.1	375.5	479.0	461.0
320	227.0	161.0	375.5	470.0	334.1	375.5	479.0	461.0
330	227.0	161.0	375.5	470.0	334.1	375.5	479.0	461.0
340	227.0	161.1	375.5	470.0	334.1	375.5	479.0	461.0
350	227.1	161.1	375.5	470.0	334.1	375.5	479.0	461.0

(continued)

A.6 Volume Estimates for Regenerated Stands

Table A-28. Timber volume tables for managed stands (cubic metres per hectare)

	Managed stand analysis units (see Table A-17. for description)							
Age (years)	**2013**	**2014**	**2021**	**2024**	**2025**	**2026**	**2029**	**2031**
10	0	0	0	0	0	0	0	0
20	0	0	0	4.7	0	0	0	0
30	0	2	0	66.8	19.6	6.6	0	0
40	0	26.0	5.0	152.6	73.6	39.8	2.1	1.0
50	0	95.0	32.7	227.8	136.2	86.6	17.2	9.9
60	0	177.0	87.4	289.7	189.2	133.5	40.2	24.2
70	0	247.0	149.3	336.1	232.2	174.3	64.3	45.2
80	1.0	318.0	200.7	371.2	270.0	207.4	91.1	67.2
90	3.0	373.0	249.3	399.5	301.9	236.1	114.9	89.1
100	16.0	411.0	300.2	422.6	325.1	259.9	137.6	110.9
110	34.0	436.0	336.4	440.9	344.2	281.9	157.4	128.9
120	56.0	459.0	365.0	454.0	358.3	303.4	173.2	145.8
130	83.0	475.0	385.3	462.1	371.2	315.9	187.9	159.7
140	110.0	489.0	402.0	466.5	381.3	325.0	200.0	171.6
150	138.0	499.0	415.0	470.6	391.3	333.9	210.9	183.5
160	162.0	506.0	424.0	474.7	398.4	342.8	222.4	194.4
170	184.0	504.0	433.9	474.7	404.5	347.2	231.4	204.3
180	204.0	506.0	442.0	474.7	409.3	352.2	239.1	211.2
190	225.0	503.0	449.2	474.7	411.5	357.0	246.1	217.2
200	247.0	503.0	451.0	474.7	414.6	359.3	251.2	225.0
210	269.0	503.0	454.6	474.7	416.6	363.1	255.0	230.0
220	290.0	499.0	452.8	474.7	417.9	365.2	258.2	235.0
230	304.0	499.0	452.8	474.7	420.9	366.2	262.1	238.0
240	320.0	499.0	451.0	474.7	421.9	369.2	265.0	241.0
250	332.0	499.0	449.2	474.7	424.9	371.3	266.1	245.0
260	342.0	499.0	447.4	474.7	425.0	371.3	269.1	248.9
270	350.0	499.0	447.4	474.7	419.1	373.3	271.0	248.0
280	357.0	499.0	445.6	474.7	412.2	373.5	272.2	248.9
290	364.0	499.0	444.7	474.7	405.4	374.6	274.1	248.9
300	364.0	499.0	444.7	474.7	404.7	374.8	274.3	248.9
310	364.0	499.0	444.7	474.7	404.7	374.8	274.3	248.9
320	364.0	499.0	444.7	474.7	404.7	374.8	274.3	248.9
330	364.0	499.0	444.7	474.7	404.7	374.8	274.3	248.9
340	364.0	499.0	444.7	474.7	404.7	374.8	274.3	248.9
350	364.0	499.0	444.7	474.7	404.7	374.8	274.3	248.9

(continued)

A.6 Volume Estimates for Regenerated Stands

Table A-28. Timber volume tables for managed stands (cubic metres per hectare)

	Managed stand analysis units (see Table A-17. for description)							
Age (years)	**2034**	**2035**	**2061**	**2064**	**2073**	**2076**	**2081**	**2084**
10	0	0	0	0	0	0	0	0
20	0	0	0	0	0	0	0	0
30	2.0	0	0	2.6	0	0	0	12.9
40	18.0	4.0	4.6	48.5	0	0	0	77.6
50	50.1	20.2	37.9	126.0	0.5	1.2	4.9	160.1
60	89.0	47.1	90.1	195.3	6.9	16.0	31.8	233.7
70	125.9	74.1	145.4	264.6	13.2	43.8	78.3	302.6
80	157.8	102.0	191.0	316.2	19.3	79.8	129.9	347.6
90	185.7	128.9	236.3	352.3	29.2	116.3	172.6	379.8
100	208.7	150.8	275.3	379.8	42.8	149.4	212.5	403.8
110	228.5	169.7	306.0	399.8	62.1	178.5	253.2	422.7
120	246.5	186.6	326.2	416.8	82.6	206.1	282.3	426.3
130	260.4	202.5	342.1	425.7	103.5	234.1	305.1	428.1
140	276.2	215.4	355.0	428.7	125.6	256.2	321.0	430.7
150	287.2	225.4	365.1	430.3	144.3	275.0	334.4	433.1
160	297.2	236.3	372.9	429.0	161.2	288.0	345.1	433.1
170	306.1	246.1	380.0	429.0	177.5	297.7	351.6	433.1
180	311.3	254.0	384.6	430.3	192.4	306.2	358.7	433.1
190	315.2	259.1	387.8	428.3	207.4	313.3	364.6	433.1
200	317.3	264.1	389.8	426.4	225.6	321.1	369.8	433.1
210	319.4	266.1	388.5	423.8	239.2	325.0	371.1	433.1
220	322.5	273.1	387.2	422.5	249.6	328.9	373.7	433.1
230	325.4	274.2	386.5	419.2	261.3	334.8	372.4	433.1
240	328.3	279.1	383.9	419.2	269.1	337.4	372.4	433.1
250	329.4	283.0	382.6	419.2	276.3	340.0	371.1	433.1
260	331.4	284.1	382.6	419.2	282.1	341.9	369.8	433.1
270	333.4	286.1	380.0	419.2	289.3	343.2	368.5	433.1
280	334.5	287.2	378.7	419.2	291.9	345.2	368.5	433.1
290	329.5	290.1	378.1	419.2	296.4	347.1	367.2	433.1
300	329.3	290.3	378.1	419.2	296.4	347.1	366.5	433.1
310	329.3	290.3	378.1	419.2	296.4	347.1	366.5	433.1
320	329.3	290.3	378.1	419.2	296.4	347.1	366.5	433.1
330	329.3	290.3	378.1	419.2	296.4	347.1	366.5	433.1
340	329.3	290.3	378.1	419.2	296.4	347.1	366.5	433.1
350	329.3	290.3	378.1	419.2	296.4	347.1	366.5	433.1

(continued)

A.6 Volume Estimates for Regenerated Stands

Table A-28. Timber volume tables for managed stands (cubic metres per hectare)

Age (years)	Managed stand analysis units (see Table A-17. for description)							
	2085	2093	2097	2101	2102	2103	2511	2514
10	0	0	0	0	0.0	0	0	0
20	0	0	0	0	0.0	0	0	0
30	1.3	0	0	0	0.4	0	0	1
40	25.8	0	0.7	8.6	17.6	0.4	0	12.0
50	83.1	1.8	8.3	56.4	56.6	14.7	4.0	63.0
60	147.4	17.9	35.6	116.6	102.4	42.3	24.0	137.0
70	203.6	46.4	74.0	171.9	144.5	74.6	68.0	204.0
80	258.1	81.1	115.0	225.9	181.2	106.6	117.0	264.0
90	300.4	116.9	151.4	264.8	215.0	133.1	166.0	328.0
100	330.4	147.5	182.9	293.9	241.2	156.8	208.0	372.0
110	353.1	175.2	214.8	316.8	259.6	179.3	247.0	404.0
120	370.5	201.5	244.5	334	273.4	197.1	288.0	429.0
130	382.5	227.6	266.7	346.3	282.2	210.6	325.0	448.0
140	391.8	249.1	283.8	351.9	290.7	221.5	353.0	464.0
150	401.5	267.2	298.7	356.5	299.0	229.9	373.0	476.0
160	405.4	279.5	307.8	360.6	302.1	234.8	392.0	484.0
170	405.4	289.9	316.3	360.6	304.9	239.0	404.0	493.0
180	404.1	298.4	323.4	360.6	304.9	242.5	417.0	497.0
190	404.1	303.6	328.6	360.6	305.3	244.3	427.0	496.0
200	402.8	309.4	333.2	360.6	304.6	247.4	434.0	495.0
210	402.2	314.0	337.7	360.6	304.6	249.5	441.0	494.0
220	400.9	318.5	341.0	360.6	303.9	251.6	447.0	495.0
230	401.5	322.4	342.9	360.6	303.5	252.3	452.0	492.0
240	401.5	326.3	344.9	360.6	302.8	253.7	454.0	491.0
250	401.5	328.3	347.5	360.6	302.1	253.4	459.0	490.0
260	401.5	330.2	347.5	360.6	301.4	253.0	462.0	489.0
270	401.5	331.5	347.5	360.6	300.7	252.3	464.0	486.0
280	401.5	334.1	345.5	360.6	299.3	251.6	462.0	483.0
290	401.5	334.1	342.9	360.6	297.6	251.3	461.0	479.0
300	401.5	334.1	342.9	360.6	297.6	251.3	461.0	479.0
310	401.5	334.1	342.9	360.6	297.6	251.3	461.0	479.0
320	401.5	334.1	342.9	360.6	297.6	251.3	461.0	479.0
330	401.5	334.1	342.9	360.6	297.6	251.3	461.0	479.0
340	401.5	334.1	342.9	360.6	297.6	251.3	461.0	479.0
350	401.5	334.1	342.9	360.6	297.6	251.3	461.0	479.0

(continued)

A.6 Volume Estimates for Regenerated Stands

Table A-28. Timber volume tables for managed stands (cubic metres per hectare)

	Managed stand analysis units (see Table A-17. for description)	
Age (years)	**2521**	**2561**
10	0	0
20	0	0
30	0	0
40	9.2	4.6
50	47.9	37.9
60	101.6	90.1
70	154.5	145.4
80	200.3	191.0
90	244.5	236.3
100	280.9	275.3
110	309.7	306.0
120	328.1	326.2
130	343.3	342.1
140	354.9	355.0
150	365.0	365.1
160	372.2	372.9
170	378.7	380.0
180	381.3	384.6
190	384.5	387.8
200	383.9	389.8
210	383.9	388.5
220	382.6	387.2
230	383.2	386.5
240	380.6	383.9
250	380.0	382.6
260	378.0	382.6
270	376.7	380.0
280	375.4	378.7
290	374.1	378.1
300	374.1	378.1
310	374.1	378.1
320	374.1	378.1
330	374.1	378.1
340	374.1	378.1
350	374.1	378.1

Appendix B

Socio-Economic Analysis Background Information

B.1 Limitations of Economic Analysis

The socio-economic analysis identifies employment and income impacts, changes in government revenues and community impacts at various harvest levels and times in the future. Some of the assumptions used in the analysis are as follows:

- **Employment multipliers** — these multipliers are used to estimate indirect and induced employment impacts of a change in direct industry activity. Employment multipliers are calculated based on analytical assumptions and data collected at a specific time. Consequently, the multipliers reflect industry and employment conditions at that time and may not accurately reflect future industry conditions. While generally good indicators when based on fairly recent information, older multipliers can be dated and may not reflect industry conditions at the time of analysis. In any impact analysis, the information should be considered as indicators of magnitude.
- **Employment coefficients** — employment impacts associated with future harvest levels are calculated using employment coefficients (person-years per 1000 cubic metres). This approach assumes that the industry structure will be the same in future as it is today. While reasonably accurate in the short term, employment coefficients may change in future as a result of changing market conditions or production technologies, for example.
- **Timing of impacts** — employment impacts are shown to occur simultaneously with a change in the harvest level. While fairly accurate for the harvesting sub-sector, this may not be the case for the processing and silviculture sub-sectors of the forest industry. Also, indirect and induced impacts will likely occur over a longer period, as business and consumer spending levels adjust to changes in harvest levels.
- **Processing thresholds** — processing job impacts are unlikely to occur in direct proportion to harvest changes (i.e., a 10% harvest reduction may not lead to a 10% processing employment reduction). Impacts are more likely to occur stepwise related to processing thresholds. A processing threshold is the level of a mill's timber supply where, when reached, will cause a mill to either lay off a shift or shut down the mill, temporarily or permanently. Accurately predicting a mill's threshold level is impossible. As a result, the analysis may overestimate processing impacts if mills continue to operate the same number of shifts, but perhaps at lower production levels, or alternatively could underestimate impacts if a mill were to eliminate a shift. Over the medium- to long-term the impact figures should be reasonably accurate, however.
- **Government expenditures** — provincial government expenditures are more related to population levels than to industry activity. As such, expenditures on education, health care and other government services are assumed to remain unchanged despite harvest changes and any subsequent change in government revenues. However, public expenditures would likely change if community population levels change sufficiently. This would amplify the community impacts of forestry job losses or gains.
- **Proportional harvest reductions** — harvest reductions are assumed to be spread proportionately among all licensees and all forms of tenure.

B.2 Economic Impact Analysis Methodology

Data sources

Data for the socio-economic analysis were obtained from several sources. Harvest volume and stumpage data are from the Ministry of Forests. Timber flow and employment data are from responses to questionnaires that were sent to licensees, operators and processing facilities in the TSA. Other general economic data are from B.C. STATS, the Ministry of Finance, Statistics Canada and local communities.

Person-year of employment

The unit of measurement for employment is a person-year. A person-year of employment is defined as a full-time job, which lasts at least 180 days per year. Part-time jobs were converted to equivalent full-time person-years of employment.

To estimate employment and income impacts associated with changes in TSA timber harvest levels, the forestry sector was divided into three sub-sectors:

1. harvesting;
2. silviculture; and
3. timber processing.

Estimating employment and income impacts involves several steps. First, the current activity in each of the three sub-sectors was assessed. Then, indirect and induced employment and employment income impacts were estimated, using data from the Ministry of Finance, and Statistics Canada. Next, employment coefficients were calculated and applied to the base case harvest forecast. Other indicators of the forestry sector's contribution to the provincial economy, such as government revenues and industry taxes, were also calculated, using Ministry of Forests stumpage estimates and other data sources.

Employment — harvesting

Direct employment in harvesting consists of all woodlands-related jobs including harvesting, log transport, log salvage, planning and administration functions. The employment multipliers used in this analysis define road building and maintenance work as indirect rather than direct employment. Including this employment in direct estimates would result in double counting.

Data on employment, place of residence and timber flows were obtained through a survey of licensees and operators in the TSA. The information was then used to estimate employment averages associated with harvest changes and the proportion of resident *versus* non-residents who work in the TSA.

Two estimates of direct employment in harvesting were calculated:

1. TSA direct employment in harvesting consists of employees who are engaged in harvesting and related activities within the TSA and who reside in communities within the TSA; and
2. Provincial direct employment in harvesting consists of employees who are engaged in harvesting, as above, plus those workers who reside outside the TSA, but who come to the TSA to work in harvesting and harvesting-related activities.

The estimates of TSA and provincial direct employment in harvesting were used to calculate employment coefficients per 1000 cubic metres. These employment coefficients were then used to estimate harvesting employment associated with the different harvest levels in the base case forecast.

Employment — silviculture

Silviculture employment consists of all basic and intensive reforestation activities, including surveys, site preparation, planting, fertilization, pruning and spacing. Silviculture employment data were collected from the Ministry of Forests and licensees whose tenures require post-harvest silviculture work. Most silviculture work is seasonal and silviculture employees usually only work part-time during the year. Because of this, silviculture jobs were converted into equivalent full-time person-years of employment. Respondents were also asked to estimate the percentage of their silviculture employees who resided within the TSA and outside the TSA.

As with the harvesting sub-sector, two estimates of direct employment in silviculture were calculated: one for the TSA and another for the province. These employment figures were used to calculate employment coefficients for silviculture employment in the same manner as the employment coefficients for harvest employment.

Employment — timber processing

Information about employment, production and sources of timber was gathered from TSA mills. Information was also gathered as to whether timber harvested from the TSA was processed within the TSA or outside the TSA. This information indicates the degree of dependence the mills have on timber harvested within the TSA. To estimate the share of processing employment supported by TSA timber, mill employment was prorated by the relative contribution of timber from the TSA to a mill's total timber requirement. For example, if 80% of a plant's timber requirement was supplied by the harvest from the TSA, then 80% of the employment in the plant would be attributable to the TSA harvest.

Employment figures were also adjusted to reflect the residences of workers: those who lived within the TSA and those who lived outside the TSA. Employment in timber processing which is supported by chip by-products from milling operations was also estimated similarly.

As with the harvesting sub-sector, two estimates of direct employment in timber processing were calculated: one for the TSA and another for the province. These employment figures were used to calculate employment coefficients for timber processing employment in the same manner as the employment coefficients for harvest employment.

Indirect and induced employment estimates

Indirect employees associated with the forestry sector are those who supply goods and services to firms directly engaged in the basic forestry sector; for example, those who provide road maintenance services, fuel and office equipment and products. Induced employment consist of those who supply goods and services purchased by employees who are directly and indirectly engaged in the industry; for example, those who work in retail outlets. Indirect and induced employment figures were calculated using TSA and provincial employment multipliers developed by the Ministry of Finance.

Two sets of employment multipliers were used for this report: migration multipliers and no-migration multipliers. The migration multipliers assume that displaced workers will leave the region, reducing total income in the region by their full wage. The no-migration multipliers assume that a displaced worker remains in the area, at least in the short term, and unemployment and other social safety net payments temporarily offset some of the income loss. Using the no-migration multipliers diminishes the induced impacts associated with a change in direct employment.

B.2 Economic Impact Analysis Methodology

The TSA and provincial employment multipliers used in the Fort St. John TSA analysis are shown in Table B-1.

Table B-1. Total employment multipliers

Forest sub-sector	TSA migration multiplier	TSA no-migration multiplier	Provincial interior migration multiplier	Provincial interior no-migration multiplier
Harvesting	1.61	1.44	2.14	1.80
Solid wood processing	1.51	1.33	2.29	1.93
Pulp	1.88	1.66	3.02	2.48

Sources: Horne, G., R. Riley, L. Ransom, and S. Kosempel. 1996. A provincial impact estimation procedure for the British Columbia forest sector. Ministry of Finance and Corporate Relations. 1999. The 1996 forest district tables.

Employment estimates of alternative timber supply levels

To estimate employment generated by alternative timber supplies, the forecast harvest level is multiplied by the calculated employment coefficients. Note that employment coefficients are based on current industry productivity, harvest practices and forest management assumptions and will not likely reflect industry operating conditions in the future. Therefore, the employment estimates should be viewed as indicators of the magnitude of change rather than as precise estimates of changes in employment levels.

Estimates of employment income

Employment income was calculated using average income estimates for workers in the forest industry. Income data are from Statistics Canada annual estimates of employment, earnings and hours. From 1998 to 2000, the average pre-tax annual income (less benefits) for sub-sectors of the forestry sector associated with the Fort St. John TSA was about $47,100 for logging and forestry services; $44,900 for solid wood manufacturing; and $56,400 for the pulp and paper sector. The weighted average annual income for direct forestry workers in the Fort St. John TSA was $47,400. The average annual income for indirect and induced employees averaged about $30,800. This figure is based on data for all service producing industries from the Statistics Canada Labour Force Survey, B.C. Industrial Comparison, average weekly wage rates. Income taxes were calculated based on marginal tax rates of 23-28% with one-third of the total income tax accruing to the province.

B.2 Economic Impact Analysis Methodology

Provincial government revenues

Except for stumpage, royalty and rents, which are specific to the TSA, provincial government revenue impacts were estimated by using industry averages. Revenues per 1000 cubic metres of harvest, expressed as dollars per 1000 cubic metres, were calculated and applied to the harvest levels in the base case forecast in a manner similar to how employment impacts were estimated. Table B-2. summarizes provincial government revenue estimates.

Table B-2. Estimates of provincial government revenue — Fort St. John TSA

	Average annual revenue 1998-2000 ($1999 millions)	Rate used
Stumpage, rents and royalties[a]	23.1	23.34 / m^3
Industry taxes[b]	9.0	9 050 / '000s m^3
(Total income tax)	(14.7)	26% blended rate
Provincial income tax[c]	4.9	one-third provincial
Total provincial government revenues	37.0	

(a) Ministry of Forests.

(b) PricewaterhouseCoopers.

(c) Based on marginal tax rates from Canada Customs and Revenue Agency (CCRA).